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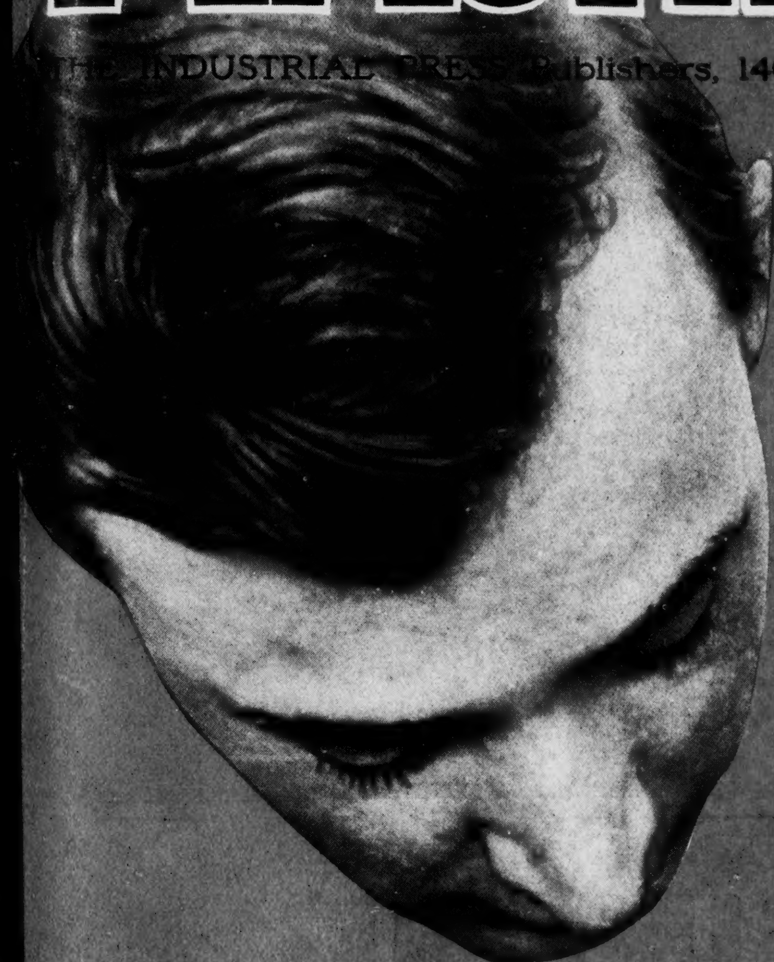
MACHINERY

THE INDUSTRIAL PRESS, Publishers, 140-148 LAFAYETTE ST., NEW YORK



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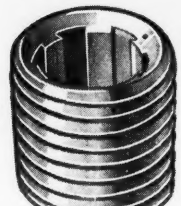

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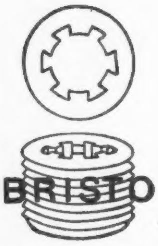

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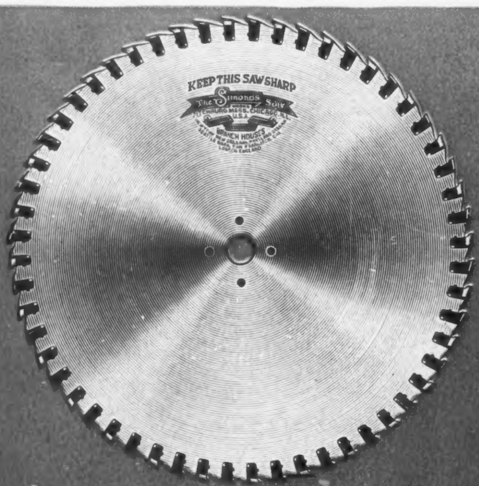

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Hot Swaging

Description of Swaging Operations, Based on the Practice and Recommendations of the Langelier Mfg. Co., Providence, R. I.

By FRED R. DANIELS

IN MACHINERY for June and July, 1921, a description of the cold-swaging process was published, including the equipment used, the effect of the process on the quality of the material being swaged, and the manufacture of swaging dies. In the present article, similar information is furnished regarding the hot-swaging of metal, based upon the use of the equipment manufactured for hot-swaging by the Langelier Mfg. Co. The process has been found especially economical in the making of carbon steel drills and end-mills and for the manufacture of motorcycle pedal pins and spinning spindles used in the cotton industry.

Operation of Hot-swaging Machine

The rolls that impart a radial movement to the dies of a cold-swaging machine are carried by a cage having a floating or slow rotary movement. This construction causes a sliding blow to be delivered to the work, which is suitable for the cold-swaging process, but not for hot-swaging. Fig. 1 shows the design of a hot-swaging machine head in which the rolls rotate on their axes while held in a fixed position; as a result the blows are delivered directly and quickly to the work without producing any torsional effect.

Rolls *A* have fixed bearings in a gun-iron ring, which is forced into the head of the machine, and they are arranged diametrically opposite each other in pairs and in such relation to the center that as the hammer blocks *B* revolve, the rolls carried in the ends of these blocks will strike against the fixed rolls and close dies *D* which are held in a slot in each of the hammer blocks. As the hammer blocks pass from roll to roll, they are moved radially outward by centrifugal force until they again contact with the next pair of rolls. This operation is similar to that of the cold-swaging machine described in June MACHINERY, with the exception of the fixed-roll feature.

On a twelve-roll machine a spindle speed of about 170 revolutions per minute is employed, thus delivering approximately 2100 evenly distributed blows around the work per minute. These machines are built in a variety of sizes and are fitted for swaging both solid and tubular work, the maximum capacity for solid work being 2½ inches in diameter, and for tubing, 5½ inches in diameter.

There is one simple and important feature in connection with the adjustment of the dies to obtain the desired opening, to which special attention should be called. In setting up the machine, shims are used back of the dies at *E* to obtain the proper force of blow, and the die opening is adjusted by means of the two cone-point headless set-screws shown in the spindle plate *C*. The points of these screws enter corresponding conical holes in the hammer blocks, and to change the die opening it is only necessary to adjust these screws.

The amount of die opening is of great importance. For solid stock, ¼ inch in diameter, it should be about 1/32 inch; for ⅝-inch stock, about 1/16 inch; and for larger sizes, in proportion. The idea is to allow enough opening so that the stock can be fed easily through the dies. Restriction of feed movement will produce inferior work, and if the work is not gripped securely, it is likely to twist. Too great a die opening permits stock to be fed fast, and for solid work this will result in chewing the material or cracking it. A large opening on tubular work will cause it to be swaged out of round.

The severe service imposed upon a machine by the swaging of hot metal demands a heavily constructed machine and means for keeping the dies cool. In the Langelier type of machines this is accomplished by placing a water jacket around the head roll bearing, which enables the machine to be kept in continuous operation, and increases its productivity. The oil from the machine and the heat produced by the hot work cause smoke, which must be carried away. This is done by providing a flue in front of the machine above the dies, and running a jet of compressed air through the hollow spindle from the rear, which forces the smoke through the flue, and at the same time carries scale and oxide away.

Arrangements for Heating the Work

Obviously some convenient arrangement must be provided for heating the work prior to swaging. In the Langelier equipment this consists of a special rotary heating furnace, such as illustrated in Fig. 3. The oven is circular, and is supported in a framework so that the stock to be heated may extend up from beneath and enter the heating chamber a short distance. The blanks to be heated are held in suitable holders arranged in a circle. The furnace is equipped with a powerful gas burner *A* which drives the flame around the circular firebrick oven, and the feed-plate in which the work-holders are carried revolves at the required operating

speed. This passes the blanks into the oven from an opening at one end and out of a similar opening at the other end where they automatically drop to a lower platform, and are then successively removed by the operator and placed in the work-holder of the swaging machine.

The speed of delivery of the heated blanks is regulated to agree with the time required for the swaging operation, so that the operator is constantly supplied with hot blanks and the swaging machine kept in continuous operation. This special equipment provides for handling work up to 20 inches in length and ½ inch in diameter. For work of this size, the maximum distance that the blanks must be heated from the end is 5 inches. The furnace can be adjusted to heat the blanks to 1800 degrees F. and deliver the work at the same rate that the swaging machine operates. For example, on ⅜-inch diameter blanks which require to be swaged 4 inches from the end, the output is about eight per minute, which is about the same as for the swaging operation.

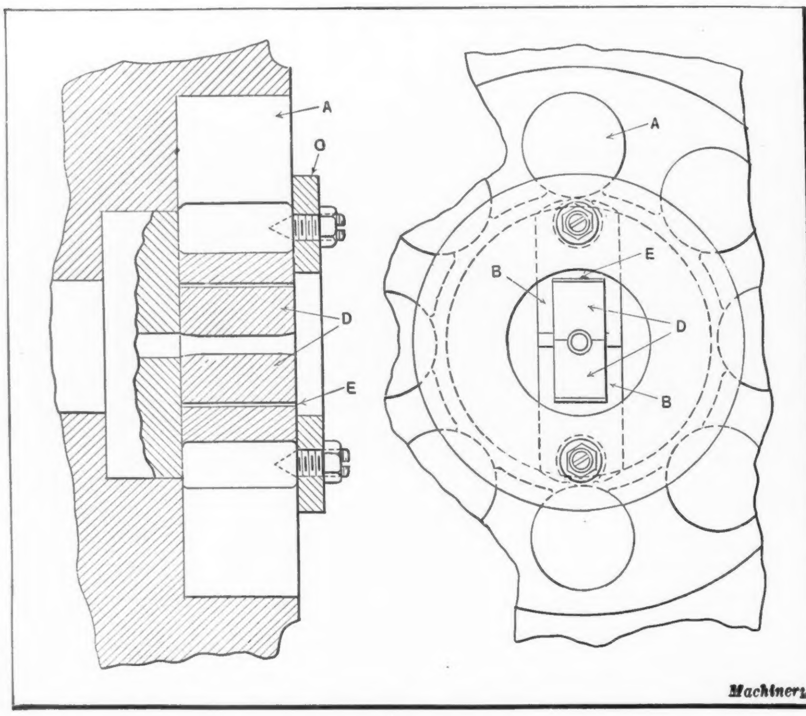


Fig. 1. Construction of the Fixed-roll Type of Swaging Machine Head

The circular opening on the inside of the furnace oven is narrow enough to accommodate the maximum diameter work and does not allow an excessive loss of heat. The rotary speed of the feed-plate is varied by suitable gearing at the lower end of the vertical shaft to which the feed-plate is attached. The furnace is located conveniently and in any position relative to the swaging machine that is best suited to the working conditions. The work is removed by tongs, placed in the work-holding chuck, and fed into the dies.

Work-holding Devices

Figs. 2, 6, and 7 show types of hot-swaging machines equipped with various designs of work-holding chucks and feeding devices. The chuck shown in Fig. 2 is of the self-opening spring type and is operated by compressed air. The compressed air forces the piston on the inside of cylinder *A* forward, resulting in a gripping action of the chuck. The work is firmly held by this means until the operation of swaging has been completed and the work withdrawn sufficiently from the dies to automatically shut off the air pressure and permit the spring to operate and release the jaws. The illustration shows the air connection *B* and the position occupied by the holder just before the automatic release of the air.

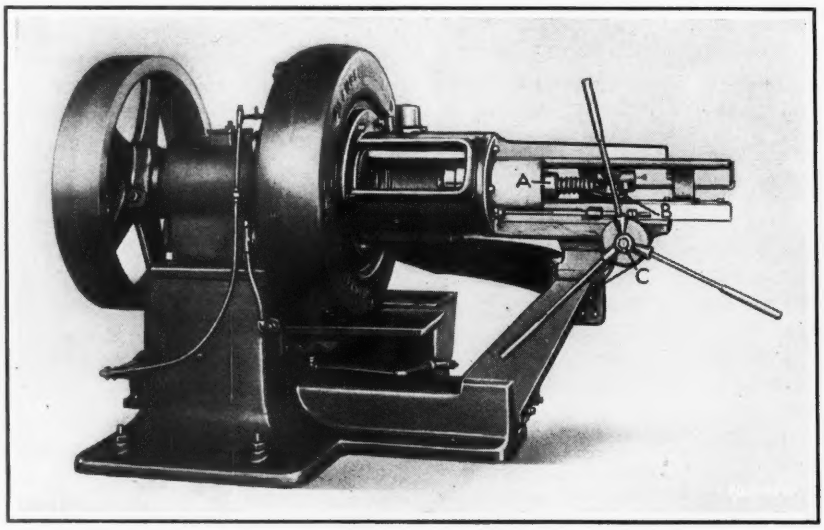


Fig. 2. Swaging Machine with Hand Feed and Compressed Air Work-holder

This machine has a hand feed, operated by a pinion on the capstan wheel shaft *C*, which meshes with a rack on the under side of the tubular holder in which the chuck is carried. The hand feed and automatic chucking device are particularly suitable for medium-sized work, but for the heavier work it is advisable to employ a more positive feed arrangement than that shown.

The holder and feed used on the machine shown in Fig. 7 are fully automatic in operation. The work is chucked pneumatically, the clamping jaws being bolted to a saddle which is fed forward and backward on the ways by hydraulic pressure, the feed being controlled by a hand-lever. The hydraulic feed is employed because it furnishes a steady movement for heavy work. The entire holding and feeding device is attached to the cover that encloses the swaging rolls, and this cover may be swung on its hinge to give easy access to the working parts of the machine.

Fig. 8 shows the cover opened, revealing the ends of the swaging rolls and the spindle plate *A* in which the two conical-point adjusting screws for obtaining the desired die opening are carried. When the cover is open, a support must be provided for the overhanging weight of the holding and feeding attachments. This is taken care of by a curved rail *B* which provides the necessary outboard support and permits the entire mechanism to be swung to the position shown. The holder is provided with a positive stop *C* for regulating the length to which the work is to be swaged.

The machine illustrated in Fig. 6 is furnished with a holder operated by a hand-lever *A*, and is extensively used on smaller classes of hot-swaged work. The feed is also hand-operated, and is of the rack and pinion type, the hand-lever for the feed being shown at *D*. This illustration also shows the smokestack *B* for the smoke caused by the hot dies burning the oil on the work, as well as the drainage receptacle *C* under the holder support into which this oil drips, and which contains a strainer for removing foreign particles from the oil, after which it drips back to the source of supply. In hot swaging operations considerable scale is produced by the rapid hammering of the hot metal, and it has been found necessary to provide for removing this foreign matter before the oil is fit to be used again.

Amount of Reduction in Hot Swaging

Small work cannot be reduced as much proportionately as larger work, due to the fact that the former does not retain the heat as well. The hot-swaging process is more particularly adapted to the production of large work than small work (which is better handled by cold-swaging), and for large heavy work a reduction of 1/8 inch on the diameter per pass is permissible, this being about twice that recommended for cold-swaging. The length of the blank also influences the amount of reduction permissible, because the distance between the dies and the holder must not be great enough to allow the work to twist due to the torsional strain produced by the die action.

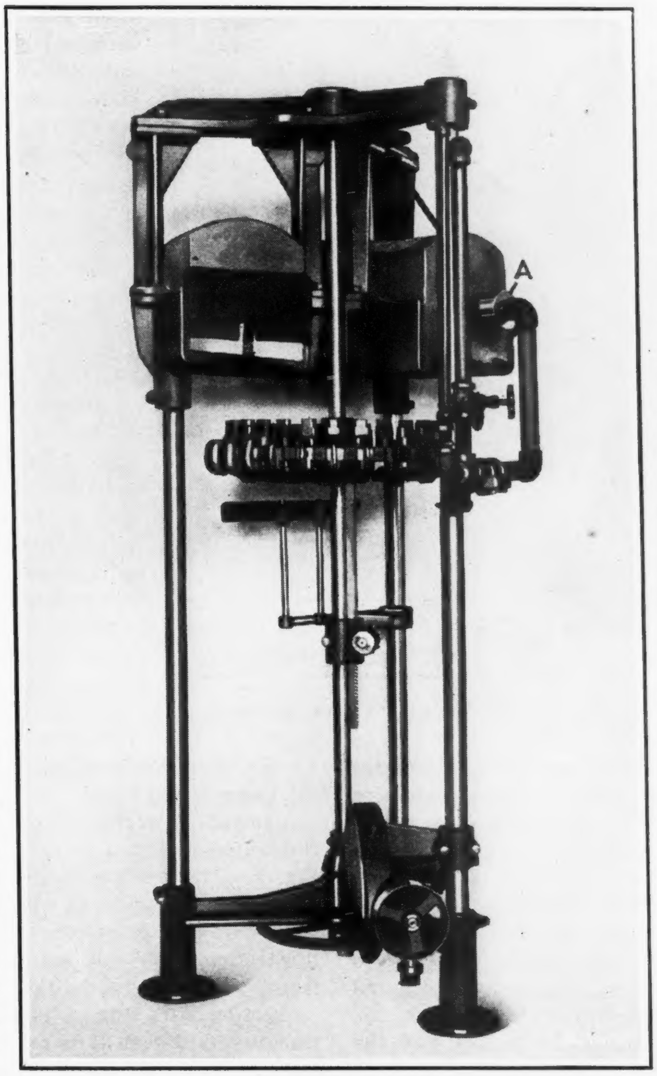


Fig. 3. Rotary Gas Furnace in which the Blanks are heated at the End prior to swaging

In determining the length to which the blanks are to be heated, it should be borne in mind that it is not necessary to heat the blank as far from the end as it is desired to swage it, since the heat from the hot end radiates into the colder metal so that the blank is heated with a uniform decrease from the end, corresponding to the taper produced by the bell-mouthed entrance to the opening of reduction dies, or by regular taper-swaging dies. That is, the blank does not need to be as hot at the end of the swaged portion as it does at the end that is subjected to the greatest reduction. Practice must determine the length to which the blanks should be heated; other factors to be considered, besides the length of the blank, are the diameter, physical qualities of the metal, type of machine, etc.

Examples of Hot-swaging

A number of examples of hot-swaged work are shown in Fig. 4. The piece shown at *A* is a bicycle pedal-shaft made from a piece of machine steel, 0.875 inch in diameter and 4 inches long. The length to be reduced by swaging is 1 3/32 inches, the first operation producing a diameter of 1/2 inch, and a length of 3 1/8 inches. Piece *B* shows the second operation on the bicycle pedal-shaft, in which the 3 1/8-inch length of the first operation is tapered to 5/16 inch at the small end. The length of the reduced portion is then 4 3/8 inches. Similar operations are performed on the opposite end of this blank, and the piece is then cut in two to make two bicycle pedal-shafts. The time required for the first operation is ten seconds and for the second operation seven seconds per piece. The piece shown at *C* was produced from a piece of drill rod, 1/2 inch in diameter, and swaged straight to a diameter of 0.290 inch for a length of 4 3/4 inches.

Example *D* is similar to that shown at *C* except that the straight reduction is 5 1/4 inches long, and this piece shows a second operation which consists of taper-swaging the 1/2-inch diameter end. It was made from a blank 4 inches long and is swaged with a standard Morse taper, at the rate of four per minute. This piece is a drill blank. The piece shown at *E* is a steel tooth for a hay rake, and is made of machine steel, tapered in one operation for a length of 1 1/2 inches to a blunt point. The production time is eight per minute. In connection with this operation, it should be mentioned that it is impracticable to attempt to produce a sharp point by hot-swaging, since a narrow die openiñg will tend to flatten the point rather than produce a uniform taper.

The swaged piece shown at *F* is a live axle end, made from axle steel 1 1/8 inches in diameter and 5 inches long. The taper is 2 7/8 inches long, the reduction being 0.74 inch in diameter at the shoulder. The small end is 1 3/32 inches long and 0.625 inch in diameter. Two operations are re-

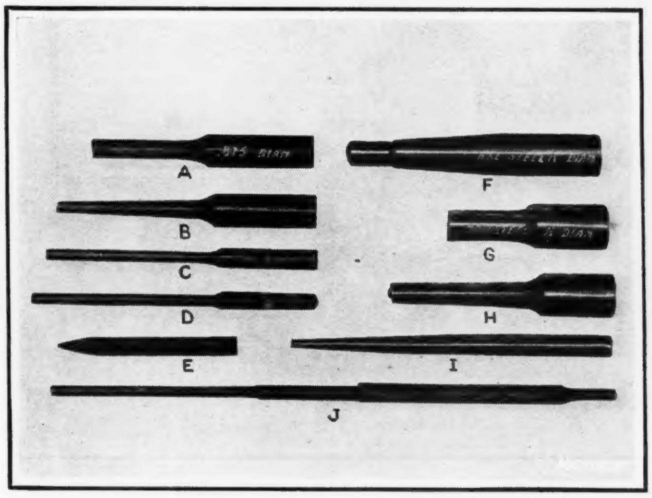


Fig. 4. Examples of Work produced by the Hot-swaging Process

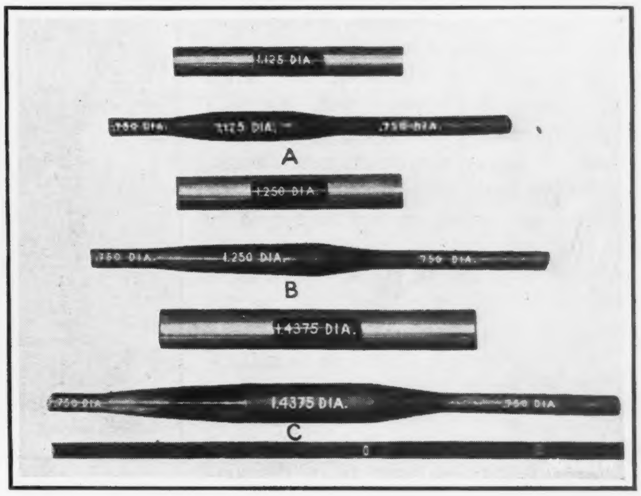


Fig. 5. Three Insulator Posts and Blanks from which they are swaged

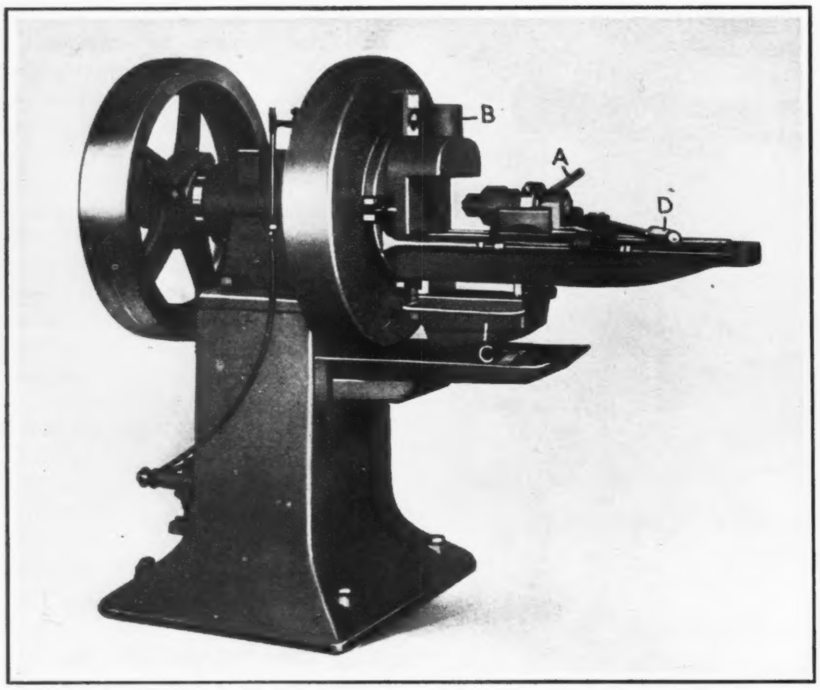


Fig. 6. Machine with Smokestack, Hand-operated Work-holder and Rack and Pinion Feeding Device

quired to produce this piece. The first operation in swaging an end-mill blank is shown at *G*, and the second operation at *H*. The material is tool steel, 1¼ inches in diameter by 3¼ inches long, and is reduced to a diameter of 27/32 inch, the length of the reduced section being 2¼ inches. In the second operation, the reduced end is tapered to 4 inches in length and a diameter at the small end of 9/16 inch. A butcher's steel is shown at *I*, this piece being made from a blank of 0.60 per cent carbon steel, 7¼ inches long and 9/16 inch in diameter. The two tapers are produced in one operation, the total taper length being 5 inches and the diameter of the small end 15/64 inch.

Example *J* is a spinning spindle used in textile machinery, and is made from special spindle steel. Three operations are required to produce this part from a blank 10 inches long and 0.562 inch in diameter, two of these operations being on the long end and one on the short end. The two diameter reductions on the long end are 0.40 and 0.27 inch, respectively, and the lengths 2⅞ and 5¾ inches. At the opposite end the stock is reduced to 5/16 inch in diameter for a length of 1½ inches. The increase in length from the original blank size is 5⅞ inches, that is, the spindle is elongated to 15⅞ inches during the three swaging operations.

Fig. 5 shows three sizes of insulator posts used for metal electric wire towers. The post shown at *A* is made from a piece of machine steel, 8¾ inches long and 1⅛ inches in diameter, which is reduced at each end, in separate operations, to 0.750 inch in diameter, the short length being 1¾ inches and the long length 6 inches. The work shown at *B* is made from a 1¼-inch diameter blank, 8½ inches long in two operations, the left-hand end being tapered to 1 inch in diameter and reduced to 0.750 inch in one operation. The length of the straight portions on this insulator post is the same as in that shown at *A*.

The third example shown in this illustration is made from a blank 1 7/16 inches in diameter and 11¾ inches long, the length and diameter of reduction and the taper being the same as in the previous case. The various lengths to which these insulator posts are made may be determined by comparison with the extension rule shown below sample *C*. These posts were made on a machine of the design shown in Fig. 2 which was operated at a flywheel speed of 190 revolutions per minute, producing the three pieces of work in ten, eleven, and twelve seconds per operation, respectively.

Additional examples of work performed on the machine shown in Fig. 2 are illustrated in Fig. 9 at *A* and *D*. The spinning spindle *A* is reduced to the dimensions given at the rate of five spindles per minute for the two operations required to produce it. This rate of production is much greater than can be realized by forging these spindles in a trip hammer, the method frequently used on this kind of work. Under test it has been shown that a hot-swaged spindle is 9 per cent stronger than a hammered spindle. A drag-link socket used in automobile construction is shown at *D*, and is produced on the machine illustrated in Fig. 2 by equipping the holder for handling tubular work. The socket is swaged in one operation at the rate of four or five a minute, being made from a piece of steel tubing 1⅜ inches in diameter, having a wall thickness of 0.124 inch.

A sample of work produced on the machine and equipment illustrated in Fig. 6 is the case-knife blank shown at *B* in Fig. 9. The work is made from a blank of 0.60 per cent carbon steel, 2½ inches long by 0.518 inch in diameter, and swaged in two operations to the dimensions shown in the illustration. For this job, as for other jobs specifically referred to in this article, the rotary gas furnace described in connection with Fig. 3 is always used with the swaging machines, although it is not shown in the illustrations. In making the case-knife blanks by the hot process, the machine is operated at 375 revolutions per minute, the output from the first operation being seven or eight a minute, and from the second five or six a minute. The small diameter end of the work is the tang of the knife, and the large end is flattened between dies to form the knife blade.

Hot-swaging of Tubular Work

In swaging tubular work, it is advisable to use a mandrel to maintain the shape and the size, except on tubing with very thick walls. At *C*, Fig. 9, are shown two examples of tubular swaging, each of which was produced in one opera-

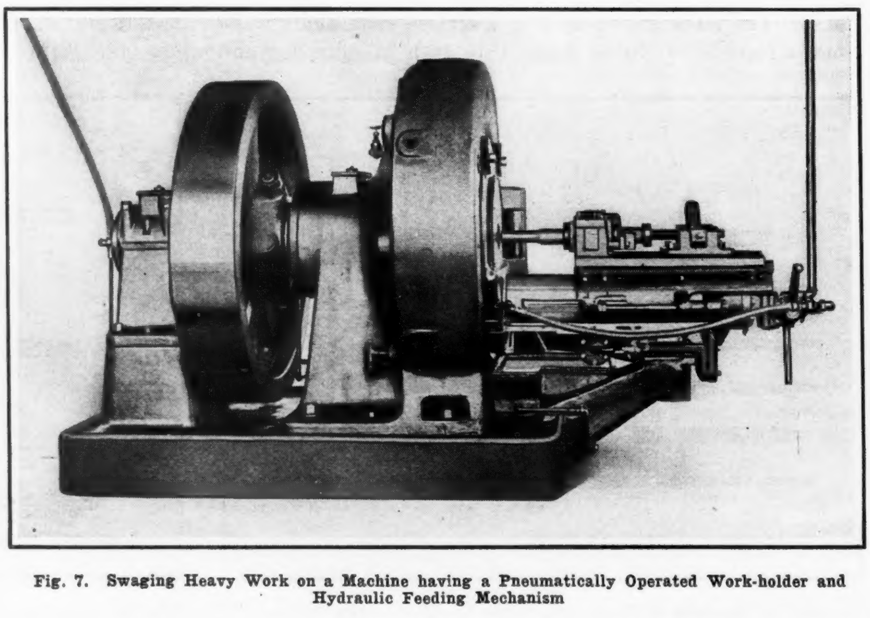


Fig. 7. Swaging Heavy Work on a Machine having a Pneumatically Operated Work-holder and Hydraulic Feeding Mechanism

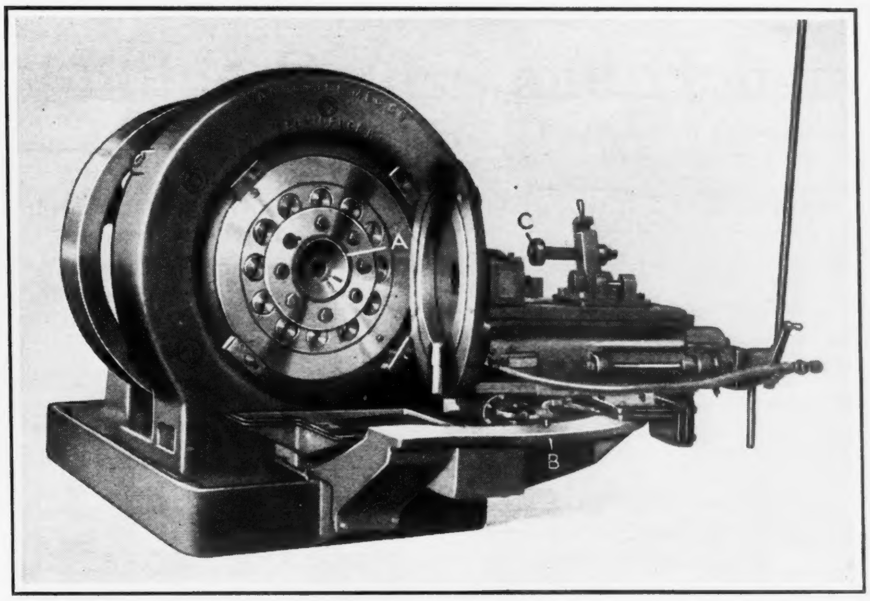


Fig. 8. View of the Machine shown in Fig. 7 with the Roll Cover and Attached Feeding and Holding Devices swung back

tion, the machine being equipped with an automatic holder and a hydraulic feed. With these attachments and with the spindle speed running at 150 revolutions per minute, the output was two pieces per minute for each part. The amount of reduction and the wall thickness are shown in the illustration. In testing the horsepower requirements for this job, it was found that 11 horsepower was required to start the machine, 5 horsepower to run without the dies, 14.8 horsepower to run with the dies without load, and from 24 to 26.5 horsepower for operating the machine under load.

A collection of tubes that have been swaged to various shapes at different times and with different equipment is shown in Fig. 10. The piece shown at *A* is produced in two operations, one being performed at each end, from tubing 21¾ inches long, with a wall thickness of ¼ inch. An example of heavy tube swaging work is shown at *B*, the wall thickness in this case being 21/32 inch. This piece was produced in one operation. An example of two-operation work is shown at *C*, the dimensions given on the sketches being self-explanatory. Three operations are required to produce the work shown at *D* from a piece of tubing 3¾ inches outside diameter, having a wall thickness of 5/32 inch. All the operations required to produce the various parts shown in this illustration were accomplished at the rate of about two pieces per minute. The type of feed and method of chucking the work will influence the rate of production as much as, if not more than, any of the other governing factors.

Making Hot-swaging Dies

The dies with which the Langelier swaging machines are equipped are made from a high grade of high-speed steel. It is proposed to outline briefly the procedure followed in making these dies, but the details will not be described here, as the manufacture of dies for hot-swaging does not differ radically from that used in making dies for the cold process, which was described in July, 1921, MACHINERY. The bars are squared up by planing, and then cut to convenient lengths on a power saw. They are next milled to die length and finished on the sides, and a pair clamped together preparatory to drilling the die groove or blade. For taper work, two or three sizes of drills are used successively to rough out the blade, so as to expedite the removal of the metal during the taper-reaming operation that follows.

For taper-reaming, a special six-flat reamer is used, similar in design to a watchmaker's broach. The rate at which the metal is removed by reaming is very slow, due to the lack of clearance on the tool, but it has been found that tools of this type produce a very accurate hole which requires little subsequent hand work when finishing the grooves or blades in the dies. Straight reduction dies are machined with an ordinary rose reamer. The tool marks produced in

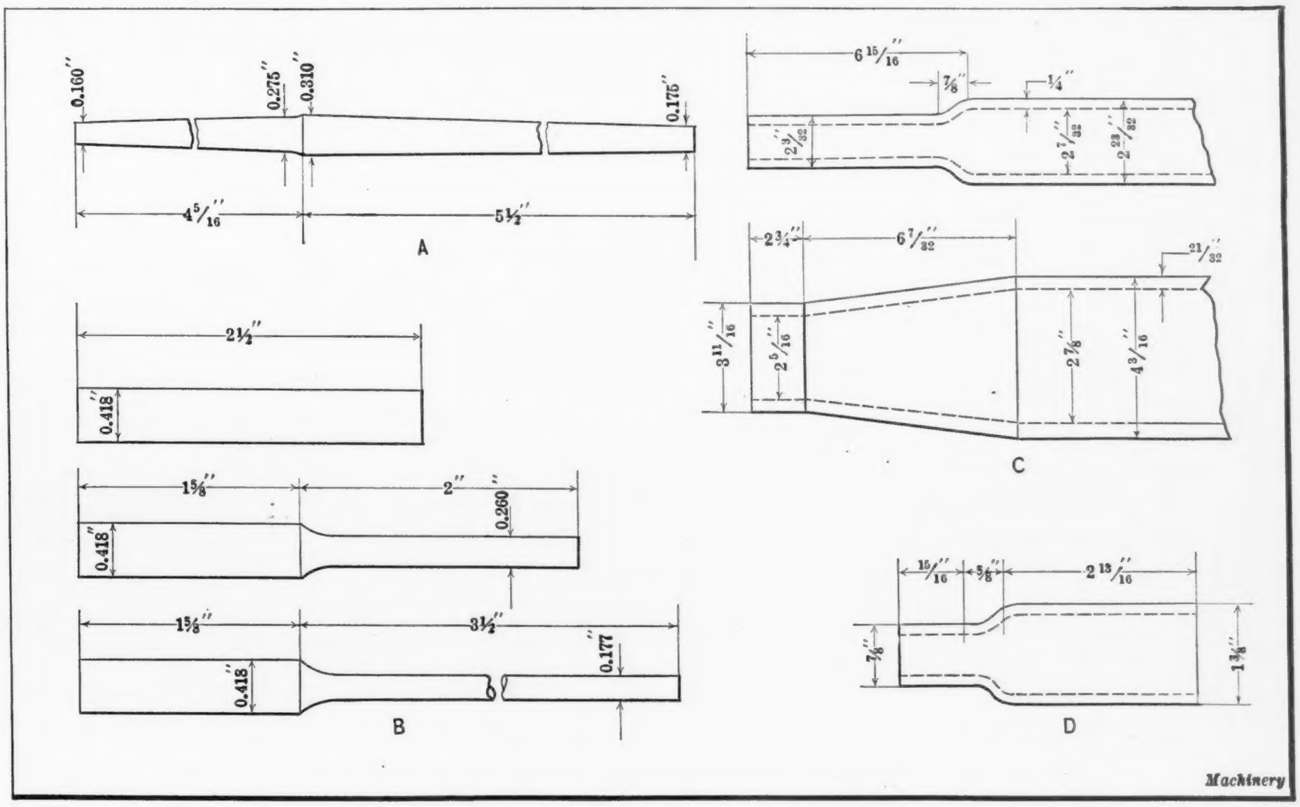


Fig. 9. Examples of Hot-swaged Solid and Tubular Work

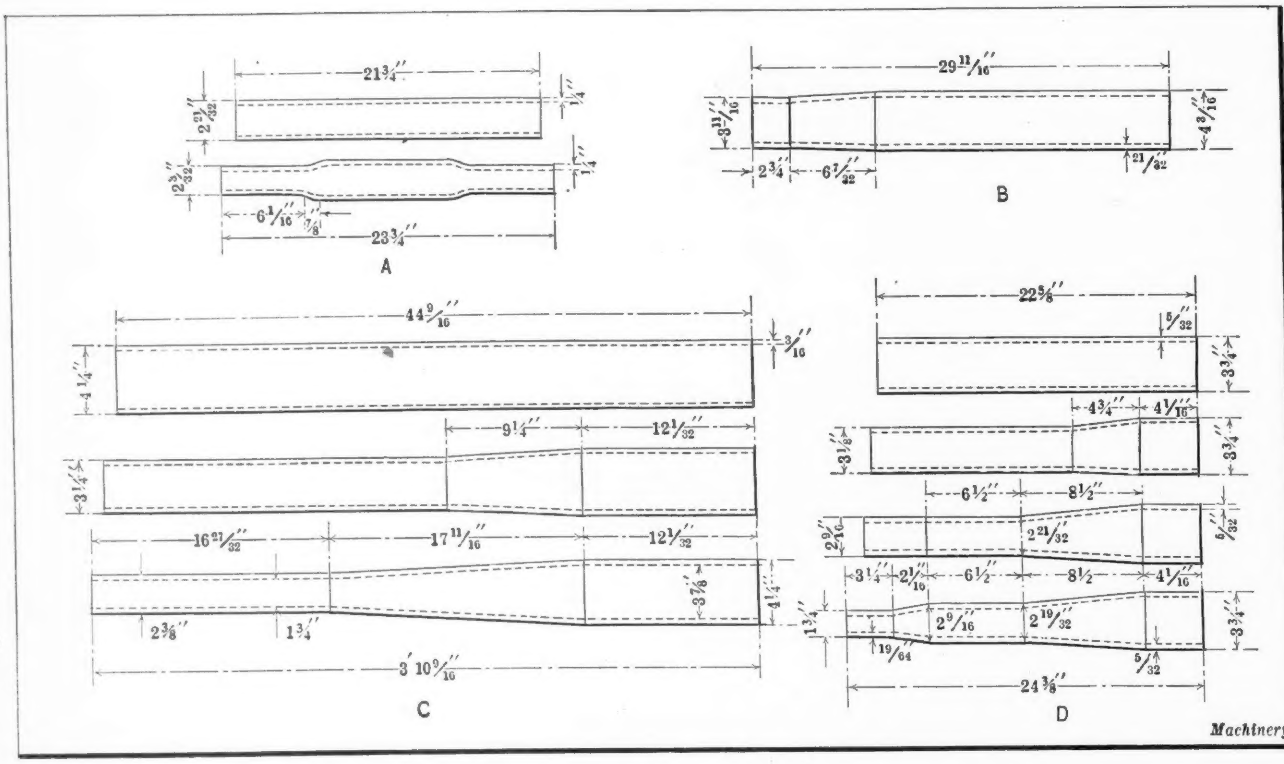


Fig. 10. Specimens of One-, Two-, and Three-operation Hot-swaged Tubular Work

reaming are then removed at the bench, and clearance at the sides of the groove is provided by means of a file. This clearance is of vital importance to allow the metal to flow as it is swaged, since the grooves are less than semicircular in contour, as was explained in describing the manufacture of cold-swaging dies in the July article.

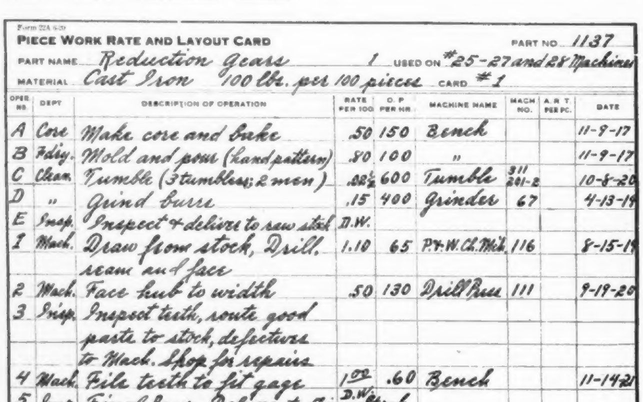
A brass lap, turned up at the same time that the reamers are made, is then used to lap the groove, the abrasive being a mixture of a very fine carborundum and oil. After the dies have been nicely finished they are hardened by preheating to 1600 degrees F. and then to 2300 degrees F. They are quenched in Houghton's No. 2 soluble oil which is kept at an atmospheric temperature, and are then drawn to a temperature of 1100 degrees F.

In making the dies for multiple-operation taper work, care is taken to see that the die grooves in successively used dies are of such size as to cause an overlapping of the operations. This maintains the desired taper and prevents ridges and uneven places from being produced.

* * *

ASSEMBLING WATCH PINION BEARINGS

Our attention has been called to the fact that the method described in the article "Assembling Watch Pinion Bearings," published on page 472 of February MACHINERY is a patented method, the patent rights belonging to the Waltham Watch Co., Waltham, Mass.



Form 22A

PIECE WORK RATE AND LAYOUT CARD PART NO. 1137

PART NAME Reduction Gears 1 USED ON #25-27 and 28 Machines

MATERIAL Cast Iron 100 lbs. per 100 pieces CARD #1

OPER. NO.	DEPT	DESCRIPTION OF OPERATION	RATE PER 100	O. P. PER HR.	MACHINE NAME	MACH. NO.	A. R. T. PER PC.	DATE
A	Core	Make core and bake	.50	150	Bench			11-9-17
B	Fdry.	Mold and pour (hand pattern)	.80	100	"			11-9-17
C	Clean	Tumble (3 tumblers; 2 men)	.02½	600	Tumble	311 201-2		10-8-20
D	"	Grind burrs	.15	400	Grinder	67		4-13-19
E	Insp.	Inspect & deliver to raw stock	D.W.					
1	Mach.	Draw from stock, Drill, ream and face	1.10	65	P.&W. Ch. Mch.	116		8-15-19
2	Mach.	Face hub to width	.50	130	Drill Press	111		9-19-20
3	Insp.	Inspect teeth, route good parts to stock, defectives to Mach. Shop for repairs						
4	Mach.	File teeth to fit gage	1.00	.60	Bench			11-14-21
5	Insp.	Final Insp. Deliver to Fin. Stock	D.W.					

Fig. 1. Front of Piece-work Rate and Lay-out Card

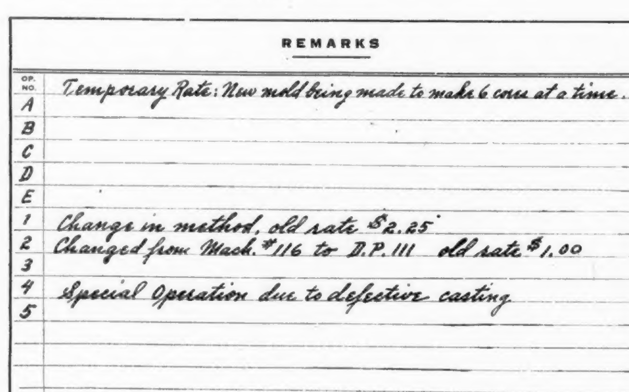
PIECE-RATE AND LAY-OUT CARD

By JOHN J. BORKENHAGEN

A piece-rate and lay-out card which the writer found of great help in his work as a rate-setter is shown in the accompanying illustrations. The front of the card, Fig. 1, contains information pertaining to the manufacture of the article, while the back of the card, Fig. 2, contains a record of changes made in the manufacturing methods and in piece rates. On the front of the card are given the part number; part name; material from which the part is made, and the weight of 100 parts; number of cards required to cover the operations; operation number; department in which work is done; description of operation; piece-rate per 100 pieces; production output per hour; name of machine and factory number; actual running time per piece; and date on which piece-rate was set. With these cards, cost data can be had on short notice. As the cards show the production labor costs and the weight per 100 pieces of material, it is only necessary to know the cost of the raw material and the overhead, to obtain the cost figures for any piece.

* * *

According to a recent Commerce Report, the Italian Government has reinstated the provisions of a decree admitting machinery and construction material for use in establishing new industries or for use in new industrial procedures, free of customs and consumption taxes.



REMARKS

OP. NO.	
A	Temporary Rate: New mold being made to make 6 cores at a time.
B	
C	
D	
E	
1	Change in method, old rate $2.25
2	Changed from Mach. #116 to D.P. 111 old rate $1.00
3	
4	Special Operation due to defective casting
5	

Fig. 2. Back of Piece-work Rate and Lay-out Card

Formed Milling Cutters and Hobs with Top and Side Rake

By HARRY E. HARRIS, President, Harris Engineering Co., Bridgeport, Conn.

COMPETENT mechanics and mechanical engineers have realized for years that it is essential, in designing cutting tools, to consider carefully the amount of top rake or hook, side rake or shear, (also known as the back and side slopes, respectively) and clearance that should be provided in order to enable the tool to remove the maximum amount of metal with the least heating and damage to itself, the work, and the machine members. Consequently no skilled mechanic would think of making a lathe, shaper, planer, or slotter tool without rake. Inserted teeth of high-power milling cutters are now also made with side and back slopes amounting to as much as 15 degrees and more, and, according to experiments recently made, milling cutters with a hook of as much as 30 degrees have a more efficient cutting action than cutters with a less angle to the hook.

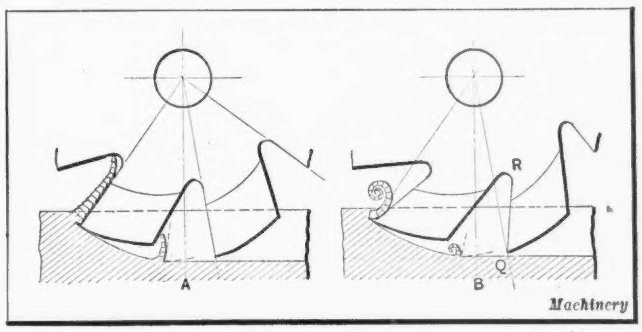


Fig. 1. Relative Cutting Actions of the Radial-tooth Hob at A and the Hook-tooth Hob at B

Instead of the chip consisting of a semi-fused distorted mass which presses against the top face of the tool, offering resistance and keeping the cooling lubricant away from the cutting edge, thus causing a severe rubbing action between the tool and the work, the chip is removed without undue distortion in the form of a curl. This results in a clean cut with much less tendency for the tool to chatter and with less power consumption. It also allows the lubricant to cool the cutting edge of the tool.

Since it is recognized that cutting edges properly ground with regard to hook and side rake have increased the efficiency of taps, face mills, broaches, lathe and planer tools, milling cutters, formed tools, reamers, counterbores, drills, etc., from at least twenty to several hundred per cent, the question arises as to why formed milling cutters and hobs without hook and side rake should be used in many shops otherwise up-to-date. Conservatism is perhaps the answer.

For instance, taking a similar case with taps, it was the general practice up to 1912 to make the face of the teeth radial to the center. With this design big losses resulted to tap users because the taps were broken, twisted, and worn out due to the hard cutting action and the jamming of chips. In a series of tests made by the writer, prior to the year mentioned, it was proved that a tap on which the teeth had top rake or hook required less power for a cut, made a cleaner job, and broke up the chips in small sections without jamming. The results of these tests were submitted to a meeting of the American Society of Mechanical Engineers at which the leading tap manufacturers were present. In a discussion following the presentation of the paper, the arguments were chiefly in favor of the practice that then prevailed of machining the taps with radial-face flutes, but in spite of the opposition, in the course of a few years there was practically no tap-maker of repute still manufacturing radial-face fluted taps.

The same thing may be expected to happen with regard to hobs and formed cutters, though some firms are now making their hobs with hook and side rake. The angle of the front face of the tooth from a radial line varies from 5 to 9 degrees in the practice of different concerns. The writer favors an angle within the limits of 7 and 8 degrees, but states that he does not know just how much greater this angle could be made with efficient results. There is no question but that an angle best suited for cutting one material under certain conditions might not be suitable for cutting the same material under different conditions or another material under the same conditions. The tooth-face angle of a hob should be made, if possible, to suit the general average of the work it is expected to do.

Fig. 1 shows at *A* an old-style hob in which the top faces of the teeth coincide with radial lines, while at *B* is shown a hob with hook teeth. The flanks of each tooth along line *QR* also have the shear or side rake feature. This is due to the fact that the hob tooth flank is angular and not truly perpendicular to the axis of the hob, and so there is actually a combined hook and side rake all along line *QR* producing an efficient cut on the working portion of the gear teeth machined by such a hob. This clean cutting action is almost impossible to obtain when the hob teeth are ground radial.

In some experiments it has been attempted to give the edge at *Q* a shearing action as well as a hook by using an even number of flutes and varying the angle of the flutes, that is, making every other flute have an angle less than the helix angle of the hob, and those in between a correspondingly greater angle. This has also been done with single gear-cutters by gashing the successive teeth at slight opposite angles. The writer has no definite data on the action of these alternate-angle cutters, but thinks that their advantage might be offset by the greater difficulty in making and grinding them, and while the action of one flank edge of the teeth would be improved by the increased angle of rake, that of the opposite flank edge would not be as good because the angle is obtuse.

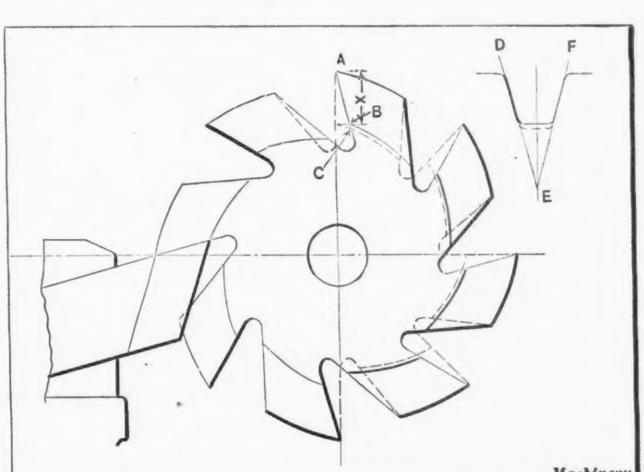


Fig. 2. Manner of tilting Cutter when relieving Under-cut or Hooked Teeth of Hobs and Formed Milling Cutters

It is as easy to produce hobs and cutters of the hook-

tooth type as it is to produce radial-tooth hobs, when the hob is backed off by a relieving machine. The relieving tool merely has to be tilted about 7½ degrees to get the proper tooth shape for an 8-degree hook, instead of setting the tool to the center. The way the tool is tilted is shown in Fig. 2. This also gives the advantage of a hook and side rake to the cutting edges of the relieving tool itself. In hobs made without this allowance for hook, that is, with the depth and tooth angle correct in a radial plane, the effect of undercutting the teeth is to give them a slightly greater depth *AC* instead of the proper depth *AB*. This will result in somewhat deeper teeth being cut in a gear than is necessary. The change in the resulting gear-tooth angle is so slight as to be ordinarily negligible, and some firms grind old stock hobs in this way without experiencing any disadvantages.

Another point for consideration is the fact that there seems to be no definite angle or amount of clearance adopted for hobs at the present time. Different manufacturers back off the same size hobs various amounts, and the same manufacturer will sometimes back off hobs of different diameters and pitches in amounts that do not vary in proportion to their size. In some cases manufacturers back off the same size hob different amounts at different times, probably because another machine is used or because a cam of a different throw happens to be in the relieving machine. It seems that since hobs and formed gear-cutters are fairly well standardized in other respects, the angle or clearance should also be standardized. If this were done, the correct tipping of the tool as illustrated in Fig. 2 could be worked out mathematically, as could also the exact foreshortening of the teeth, or the distance *X*, and the slight change in the angle *DEF*.

It is well known that cutting tools on which the teeth are hooked require less clearance than tools on which the teeth are not under-cut. The chief advantages of providing a hook on hob and cutter teeth may be briefly summarized as follows: Greatest possible production due to the ability to take heavier cuts at greater rates of feeds and speeds; more output between the hob grindings; less metal to remove from the hob when ground; smoother cutting action and less chatter; less power required and consequently less strain on the machine members and the hob teeth; and less clearance required for the teeth. Some materials on which it was found impossible to obtain a smooth finish when using radial-face hobs have been satisfactorily machined after grinding the hob teeth to the hook style.

* * *

FORMULAS FOR PRESSURE REQUIRED FOR SHEARING METAL

By D. C. OVIATT, D. C. Oviatt & Co., Cleveland, Ohio

The amount of shear or inclination necessary either for a shear blade or for shearing and trimming dies is variable and depends jointly on the physical condition of the metal being sheared or trimmed and the length of cut or distance around the die opening.

Shear may be expressed either as a fraction of the thickness of the stock to be sheared or as inclination of the shear blade in inches per foot. When expressed as a fraction of the thickness of the stock, the terms ¼ shear, ½ shear, 1½ shear, etc., are used. This is diagrammatically shown in the accompanying illustration. The thickness of stock is indicated by *X*, and the shear as a fraction thereof. For example, two cases are shown at *A* in which the shear blades are provided with ½ shear, that is, a rise of blade equal to one-half the thickness of the stock. Likewise, the blades shown at *B* are provided with ¾ shear. A blade having any given shear, as explained in the foregoing, will require the same pressure to force it through a plate, regardless of whether the blade presents one cutting edge or several. For instance, the pressure required would be the same for both cases shown at *A*, or for both shown at *B*, although the blades at the right have three points in contact, while those at the left have but one.

Pressure Formulas for Shear Calculation

When the shear is expressed as a fraction of the plate thickness, the following formula may be used to determine the pressure required to force the blade through the plate:

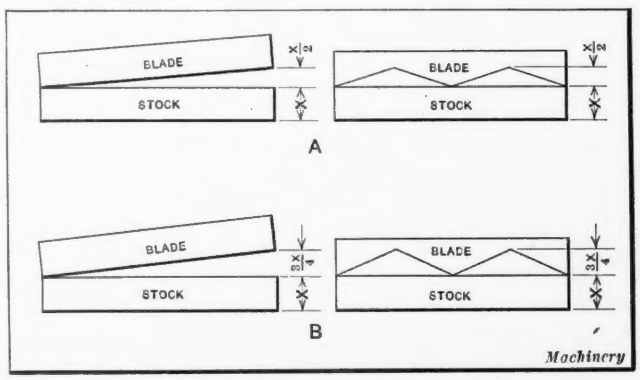
$$W = \frac{ldf}{c}\left(t - \frac{dt}{2}\right) \qquad (1)$$

When the shear is to be calculated without regard to the length of cut, or the boundary line of the die opening, but rather with relation to the inclination of the die face in inches per foot, the following formula should be used:

$$W = \frac{6dt^2f(2-d)}{s} \qquad (2)$$

In these formulas

W = pressure in pounds required to force blade through plate;
l = length of cut in inches in a straight line or in a line bounding an opening to be cut;
f = ultimate shearing strength of material in pounds per square inch;
t = thickness of plate in inches;
c = shear, expressed as a fraction of the thickness of the flash;
s = shear, expressed as inclination of the die face in inches per foot;
d = constant.



Diagrammatic Illustration of ½ and ¾ Shear for Trimming Dies and Shear Blades

The constant d is that fraction of the plate thickness through which the shear blade must be forced before the shearing resistance of the material is overcome. The value may usually be taken as 1/3 for cold steel, but may vary from ¼ to ½, or even more, according to the condition of the shear blades or to the nature of the material being cut. Obviously this factor will be less for hot material than for cold, and greater for steels of higher shearing strength.

Application of the Formulas

Considering first the shear as expressed as a fraction of the plate thickness, what pressure will be required to shear a plate ¾ inch thick, 18 inches long, the blade being provided with ½ shear? The ultimate shearing strength of the material is 50,000 pounds per square inch.

The values for the different factors are: $t = 3/4$; $c = 1/2$; $d = 1/3$; $l = 18$; $f = 50{,}000$; so by applying Formula (1)

$$W = \frac{18 \times 1/3 \times 50{,}000}{1/2}\left(3/4 - \frac{1/3 \times 3/4}{2}\right)$$
$$= 600{,}000 \times 5/8 = 375{,}000 \text{ pounds.}$$

In applying Formula (2) to the solution of the same problem,

$$W = \frac{6 \times 1/3 \times (3/4)^2 \times 50{,}000\ (2 - 1/3)}{1/4}$$
$$= 7.5 \times 50{,}000 = 375{,}000 \text{ pounds.}$$

Planing Large Spur Gears

Application of Gear Planers which Cut Gear Teeth by Reproducing the Shape of a Templet

By FRANKLIN D. JONES

LARGE gears of coarse pitch may be cut either by planing on a templet or form-copying type of machine, by milling with a formed cutter, or by hobbing. Most gear manufacturers use the templet planer for the very large gears. One advantage of this type of machine is that simple, inexpensive tools are used, and this is very important, as often only one of these large gears is required, and the cost of making a formed cutter or hob would be prohibitive.

Gear-cutting machines of the templet type are also used for cutting large bevel and herringbone gears; in fact, gear planers of this class are used invariably for cutting very large bevel gears. Some gear planers are designed for cutting spur gears exclusively, but there are also combination types which may be applied to either spur or bevel gears.

A characteristic feature of the templet planer is the templet or master former which serves to guide the planing tool, thus causing it to plane teeth having the correct shape or curvature. When the planer is at work, a slide or head which carries the tool is given a reciprocating motion, and as the tool feeds inward for each stroke, the path it follows is controlled by the templet. The traversing movement of the tool-slide is derived from a crank on some gear planers, whereas others have a reversing screw. Still another method of traversing the head is by means of a rack and pinion, the latter being arranged to rotate in opposite directions.

There are two general methods of machining the teeth on one of these planers. One is to rough out the teeth with a single-pointed tool and then finish with a formed tool which removes the feed marks and gives the teeth a smooth finish. The other method is to take both roughing and finishing cuts with single-pointed tools. The use of the formed tool for finishing is impracticable for the larger pitches which are finished by a single-pointed tool. The number of cuts required depends upon the size of the tooth, amount of stock to be removed, and the kind of material.

Operating Features of Templet Type Gear Planers

One of the Gleason planers of the type designed exclusively for cutting external and internal spur gears is shown in Fig. 1. The tool *A* is held by a slide which can move vertically. This slide is connected with another slide that is given a horizontal feeding movement after each cutting stroke of the tool. A roller *B* attached to the vertical slide, rests upon a templet *C*, which is stationary. When the horizontal slide feeds inward for taking a finishing cut, the tool planes one side of the tooth to the required curvature, because the path it follows is controlled by the shape of templet *C*. Sets of these templets are supplied with a gear planer, one templet of each pair being for the upper sides and the other for the lower sides of the teeth. Each pair of templets in the set covers a certain range of diameters and can be used for planing any pitch from the smallest up to the pitch stamped on the templet, which requires the full length of curve of that templet. The entire tool is mounted upon a large main slide that is traversed by a crank type of drive on the particular machine shown in Fig. 1.

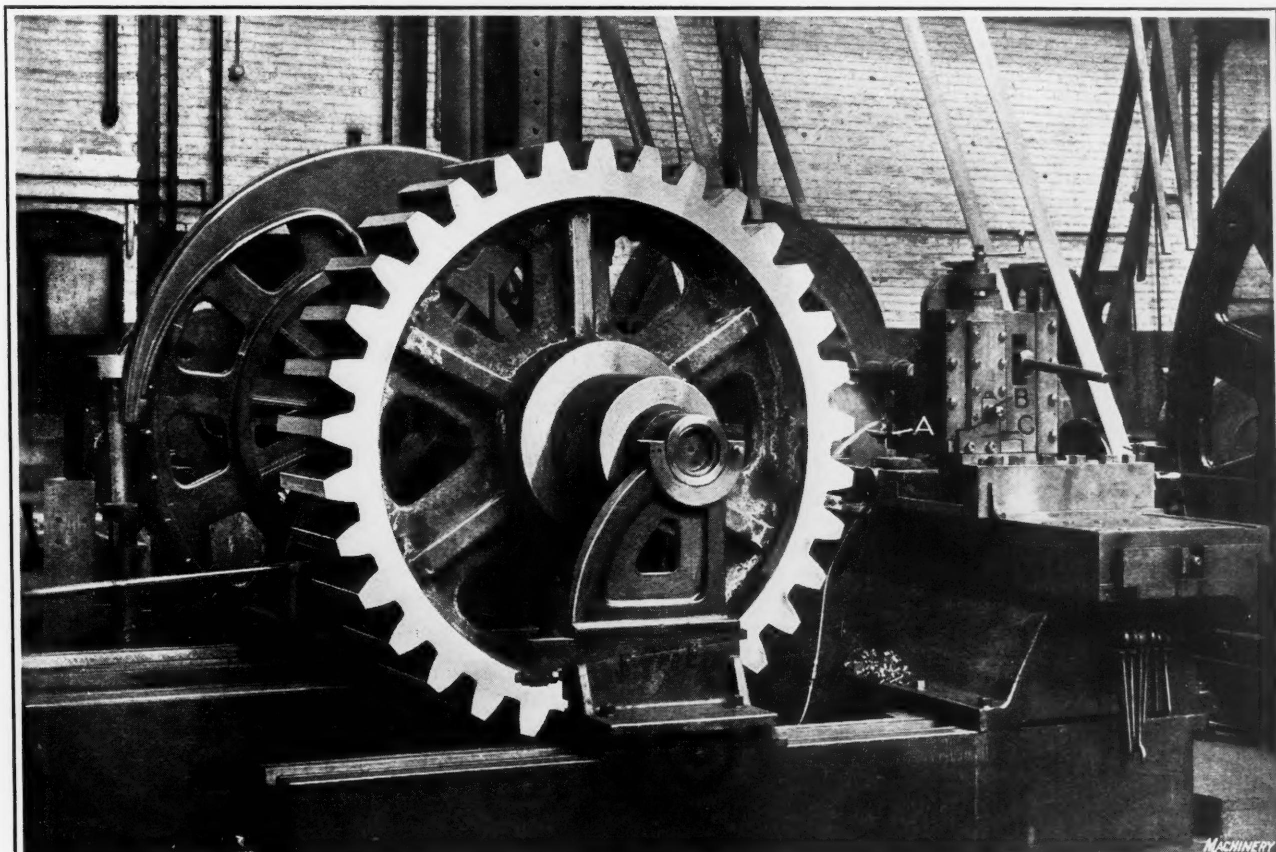


Fig. 1. Gear Planer of the Templet or Form-copying Type with Finished Spur Gear in Position

The indexing mechanism may be seen in Fig. 3 which shows another machine of the same general type set up for

cutting a larger gear. The large dividing wheel *D* is engaged by a worm connecting with a mechanism for controlling the indexing movement. After one side of a tooth is planed, the index mechanism is tripped by the operator, and then the gear is automatically rotated an amount equal to the circular pitch of the gear being planed. The power for this indexing movement is supplied by a small auxiliary motor *M* forming part of the indexing mechanism. The tool-slide of the machine shown in Fig. 3 is also motor-driven.

The thrust of the cut on these gear planers is taken by a rim support mounted on brace *E*. This support, which bears directly against the rim while the planing tool is at work, must be withdrawn slightly to permit the gear to swing freely while indexing. This is done by hand, by means of handle *F*. Gears of different diameter are accommodated by shifting along the main bed, the head carrying the work-spindle and also the bearing (see Fig. 1) for the outer end of the work-arbor.

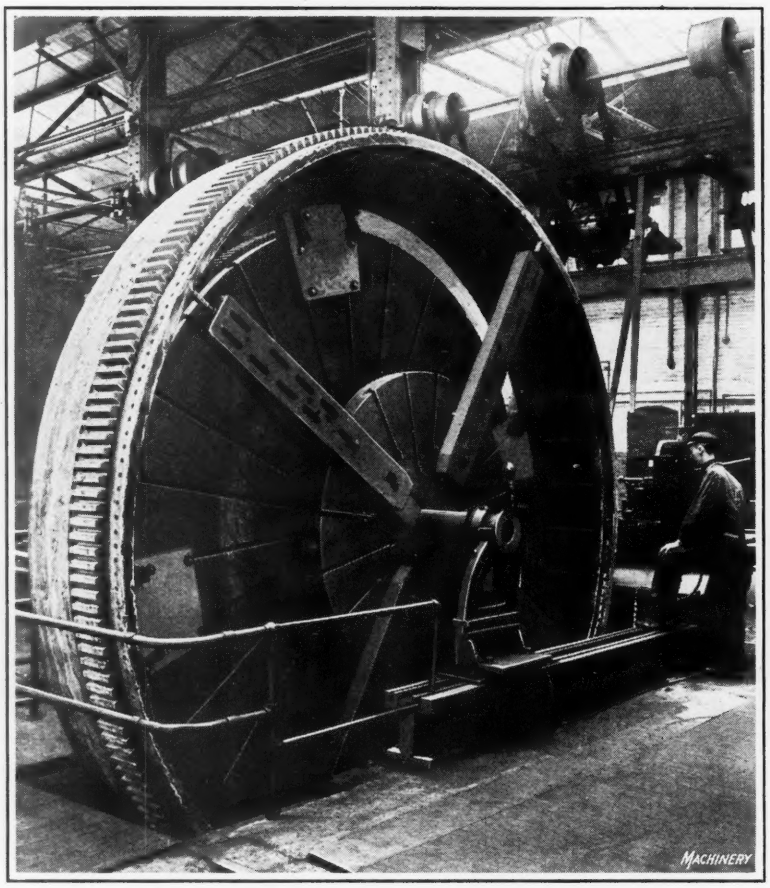


Fig. 2. Gear Planer provided with a Pit for swinging Large Gears

As a general rule, gears having a circular pitch of two inches and smaller are planed with tools which are used for both the sides of the teeth and the fillets at the bottom, but for coarser pitches, different tools are used for the sides and the fillets. A line representing the root circle is marked on one side of the gear blank, preferably by using a sharp-pointed tool at the time the blank is turned. When these gear planers are used for cutting internal gears, a special attachment is employed, which will be described in a subsequent article in connection with the cutting of internal gears.

Examples of Large Spur Gear Planing

When gear planers are used for gears having a larger radius than the distance from the center of the work-spindle to the floor, a pit is provided in order to increase the capacity of the machine. Figs. 2 and 4 show front and rear views of a planer at the Gleason Works, Rochester, N. Y., cutting a large gear which enters a pit beneath the floor. This machine is similar to the type just described. The gear teeth are on a large ring-shaped casting. In order to hold this casting, a large auxiliary faceplate was mounted on the work-spindle. The regular faceplate is located in front of the auxiliary faceplate. Four supporting arms are bolted to each of these faceplates for holding the ring-gear in position. As Fig. 4 shows there are gear teeth on the rim of the auxiliary faceplate to permit revolving it by a direct drive when it is necessary to turn the rim of a large gear which is beyond the capacity of machines generally used for turning operations. These planers for large gears are equipped with

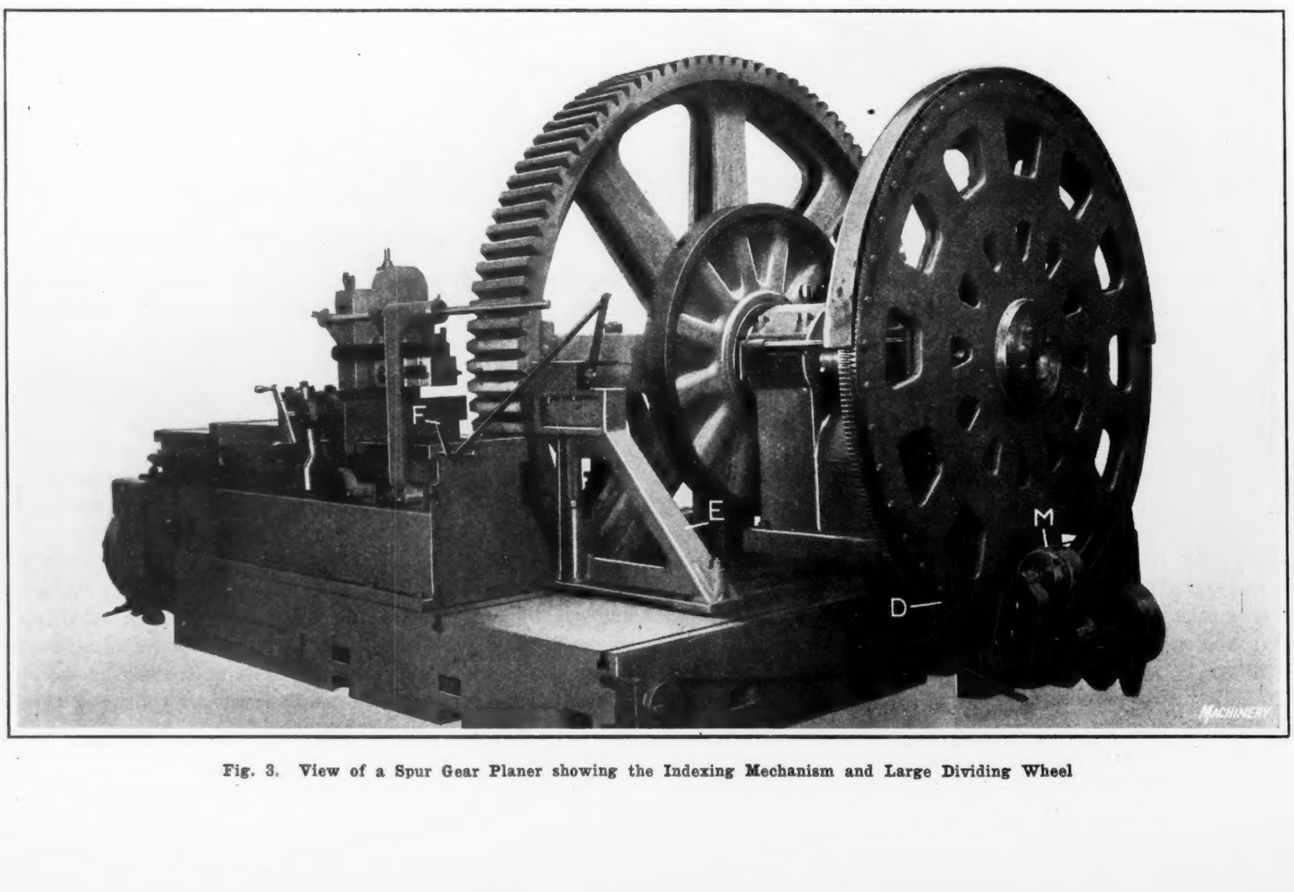


Fig. 3. View of a Spur Gear Planer showing the Indexing Mechanism and Large Dividing Wheel

dividing wheels of large diameter (see the illustration Fig. 4) to minimize indexing errors.

Another example of large spur gear planing is shown in Fig. 5. This illustration was obtained from the plant of the Farrell Foundry & Machine Co., Ansonia, Conn. An idea of the size of this gear may be obtained by comparison with the operator. The pitch diameter of the gear is 16 feet 10½ inches, the circular pitch 6 inches, and the face width 18 inches. This is another operation illustrating the use of a pit to provide room for swinging a large gear. It will be seen that this planer is of the same design as that illustrated in Fig. 1.

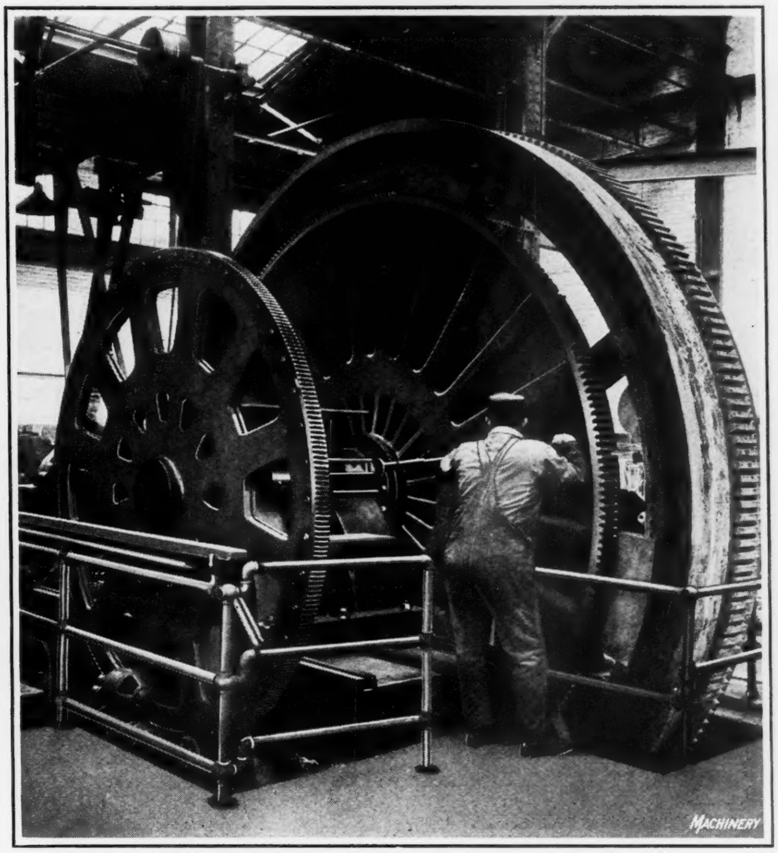


Fig. 4. Rear View of the Planer shown in Fig. 2. Note Large Dividing Wheel at Left-hand End of Work-spindle

Combination Gear Planers

Planers designed for cutting either spur or bevel gears differ from the type used for spur gears only, especially in regard to the arrangement of the main slide upon which the head is traversed. One end of this slide is provided with both vertical and horizontal bearings. The vertical bearing permits it to swing horizontally, and the horizontal bearing provides for a vertical movement. A feeding mechanism controls the horizontal motion, whereas the vertical movement is controlled by a former engaged by a roller attached to the outer end of the main slide. These combined horizontal and vertical movements cause the tool to follow the converging form of a bevel gear tooth. The toolholder used for bevel gears does not have a cross-feed relative to the main slide, but when planing spur gears another tool-head having this lateral feeding movement is used and then the main slide is held stationary in a position parallel to the axis of the gear. On planers of the combination type, the head which carries the gear blank has not only a side adjustment to care for different diameters, but also an adjustment that makes it possible to set bevel gears of different angles so that the apex of the pitch cone of the gear will coincide with the "center of the machine."

Gear Teeth Cast to Approximate Shape

Rough or unplaned blanks for large gears, such as are cut on the templet type of gear planer, ordinarily have rough-cast teeth, which are left thick enough to allow for planing. When the teeth are cast, it is not necessary to remove so much metal when machining them, although these cast teeth have a hard scale which offsets, more or less, the advantage men-

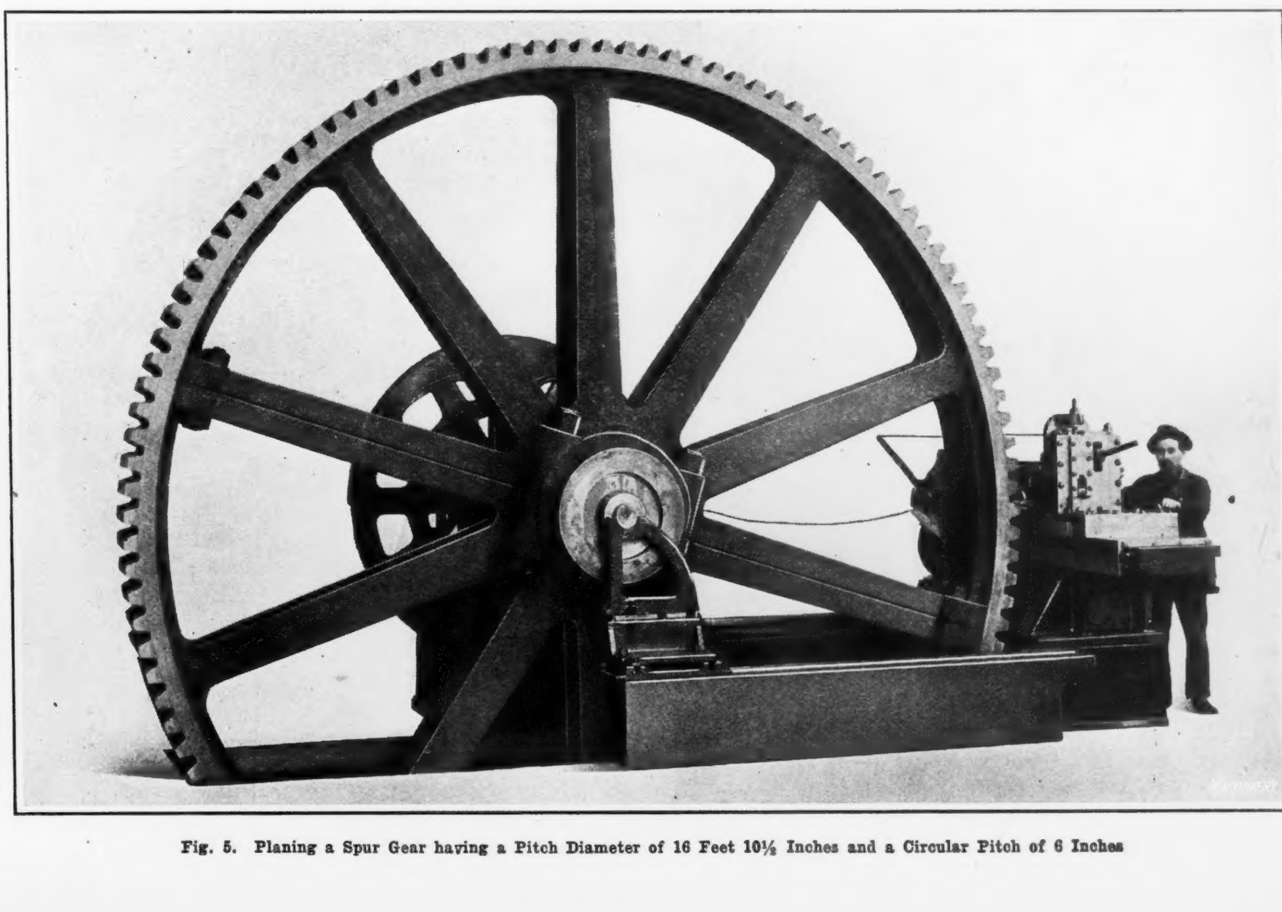


Fig. 5. Planing a Spur Gear having a Pitch Diameter of 16 Feet 10½ Inches and a Circular Pitch of 6 Inches

tioned. Because of this fact it is easier to cut the teeth "from the solid" in some cases; however, there is a good reason for casting the teeth to the approximate shape required. When the teeth of large gears are cast, this tends to insure soundness in the rim of the casting and tooth surfaces free from defects. On the contrary, if coarse teeth are cut from a solid rim, blow-holes or other interior defects might be encountered, especially in those rim sections adjoining the spokes or arms. According to one authority, there is no advantage in casting the teeth if they are smaller than one diametral pitch.

Cutting Large Gears on Templet Planer of Vertical Design

Another design of gear planer adapted for machining large spur gears is illustrated in Fig. 6 which shows a machine built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. The tool-slide has a vertical reciprocating movement when the machine is at work. This traversing motion is derived from a rack and spiral pinion drive, the latter being rotated in opposite directions by open and cross belts similar to the arrangement of a planer drive. The vertical column may be adjusted along the horizontal bed to suit the diameter of the gear, and this machine will plane gears up to 40 feet in diameter.

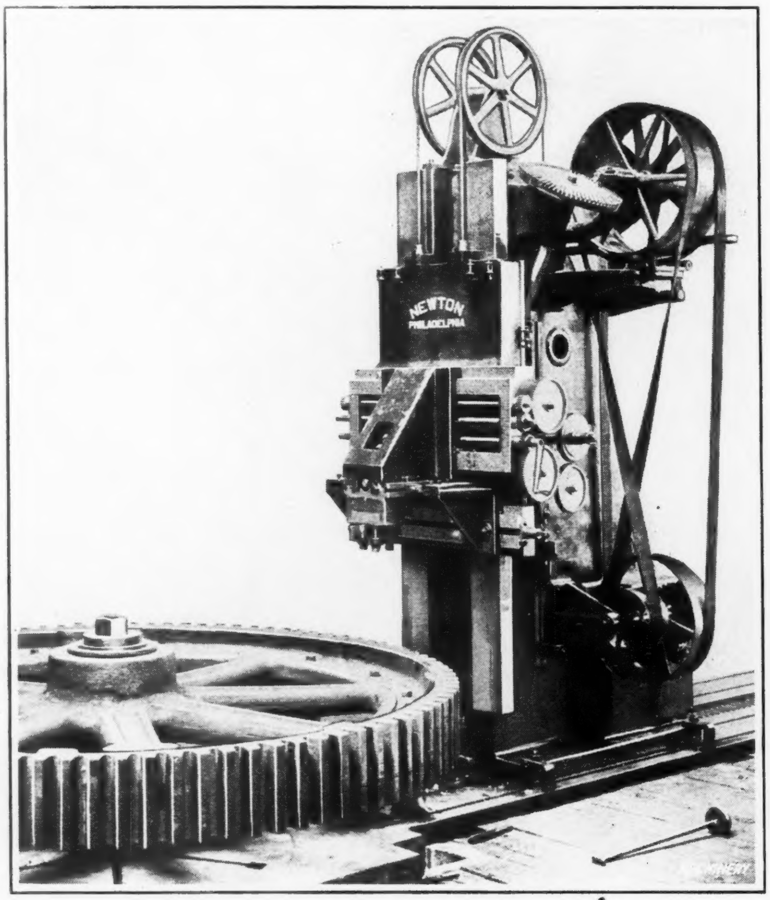


Fig. 6. Spur Gear Planer of Vertical Design

The templets controlling the path followed by the tool as the latter feeds inward are attached on each side of the tool-slide. One templet controls the tool movement when planing one side of the teeth, and the templet on the other side of the tool-slide is used when planing the opposite sides of the teeth. When the planing tool is at the top of its stroke, it feeds inward for taking the next cut and at the same time the tool-slide is given a lateral movement under control of whichever templet is in use. This lateral movement is obtained from a "star feed" in conjunction with a friction device, that allows for whatever slipping may occur after proper contact with the templet has been obtained. The indexing movement is derived from a motor which transmits motion through change-gears and worm-gearing to the work-table. This indexing mechanism is controlled by simply releasing a hand-operated plunger which allows the motor to rotate the work-table and gear an amount equivalent to the circular pitch.

* * *

France is now the leader among European nations in tonnage of iron ore reserves, having 35 per cent of the total tonnage for the Continent; the United Kingdom follows with 18 per cent, Sweden with 12.5 per cent, and Germany with 11 per cent. Central and southern Russia, Spain, and Norway are the only others possessing more than 2 per cent of the total, according to a recent report (Bulletin 706) issued by the Geological Survey.

NUMBERING TOOL DRAWINGS

By JOHN E. COLLINS

Having twice been called upon to devise and install a drawing number system, and believing that the simplest way of doing anything is always the best, the writer developed the following method of numbering tool and pattern drawings. No cross-index systems are required to find the tool drawing for any part, or to determine from a tool drawing what parts are to be machined with the tool shown on that drawing.

The part number the tool is designed for is used in all cases as the base for the tool number. Thus if the part number is 4500, the tool number will also contain the number 4500. This ties the tool number up with the part it is to be used on. To take care of tools of different sizes, it is necessary to have the drawings on sheets of various sizes. This makes it desirable to include some method of noting the size of the sheet on which the drawing is made, as a separate file is preferable for each size drawing regularly used.

The tool numbers for the various operations on any one part are distinguished from one another by simply using the operation number of the part. On the tool drawing sheet a space is provided at one side of the general title for the model and part number. If at any time a new model is released for manufacture and the tool can be used on this model also, this information is noted on the tool drawing. It should be remembered that the details must be drawn on sheets which are the same size as those used for their tool lay-out drawings.

For example, let the tool number 4-4500-6 be selected. The first number 4 identifies the sheet size. In the plant under consideration there are four sizes. The number 4 indicates that the sheet is 24 by 36 inches. The number 3 would indicate a sheet 18 by 24 inches, number 2 a sheet 12 by 18 inches, and number 1 a sheet 9 by 12 inches. Therefore, if we have the tool number we also have the sheet size, which in turn indicates what cabinet and drawer it is filed in.

The next number is the part number 4500, which identifies the tool with the part. By knowing the part number it is an easy matter to find the tool number, or vice versa. The last number 6 identifies the operation number on the part 4500 and at the same time serves to distinguish between tools used on the same part. If more than one tool is used for one operation letters A, B, C, etc., are used to identify them.

Tool pattern numbers are the same as tool drawing numbers. If more than one pattern is required for any one tool, the pattern numbers have a prefix attached, thus: A, B, C, etc. The operation-sheet forms are typed on very thin paper with carbon paper backing up the letters on the rear side. This allows any number of duplicate blueprints to be made from the original operation sheets.

Operating a Factory with a Reduced Force

By JOHN C. LEASE, General Superintendent, Houston, Stanwood & Gamble Co., Covington, Ky.

THE organization and methods for operating a factory economically when run at full capacity are not always applicable when the factory is running at only 25 or 30 per cent of capacity. Many manufacturers have become keenly aware of this fact during the past year. At the Houston, Stanwood & Gamble plant the problem arose of operating the factory profitably at 30 per cent capacity. By adopting a unique method of control and enlisting the interest and co-operation of the employes, it has been possible to accomplish noteworthy results in this direction, and the factory has been run on a paying basis in spite of the reduced business.

Chart Showing Productive and Non-productive Labor

In any scheme of management the secret of success is to reduce the non-productive labor hours to a minimum, while maintaining the productive labor hours at a maximum. The first thing to be done in running a factory on a reduced scale is to investigate the proportion between productive and non-productive labor hours. The term "productive labor hours" means time spent in directly producing such products of the company as are sold to customers. The expression "non-productive labor hours" designates time spent on maintenance and equipment, experimental work, store-rooms, supervision, shipping, watchmen, etc. If an investigation is made in the average shop during the period of depression when the shop is engaged at but a small percentage of capacity, it will be found that non-productive working hours run up to an unexpected figure, as compared with productive hours.

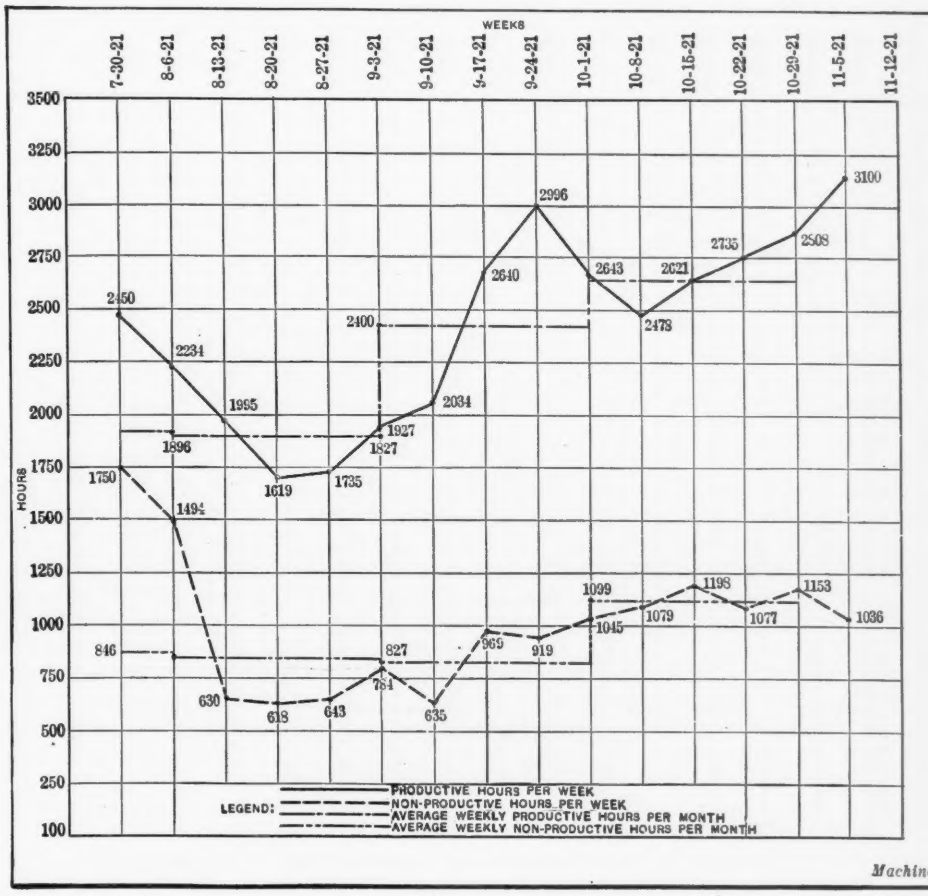


Fig. 1. Chart showing the Relation between Productive and Non-productive Hours, Weekly and Monthly

Fig. 1 shows what such an investigation revealed in the plant of the company referred to, when the system of control to be described was first put into operation. There were 1750 non-productive hours per week, as compared with 2450 productive hours. The first step was to reduce to a minimum the amount of non-productive labor being performed about the shop, and, as will be noted from the chart, in three weeks' time the non-productive time was reduced to 618 hours. Meanwhile the productive hours decreased also, due to a lack of orders, but the proportion between productive and non-productive hours was far more favorable at the end of the three weeks than at the time when the chart was begun. At the end of each week the total number of productive and non-productive hours is noted on the chart, and the entire scheme of holding down the non-productive work is explained to the employes, so that they take a remarkable interest in seeing the productive curve rise while the non-productive remains either stationary or falls. It has been explained to the employes that only by increasing the productive labor hours in proportion to the non-productive can the firm expect to do a business profitable enough to keep them permanently employed, and the interest taken in this matter by everybody in the entire factory is an indication of the possibilities of teamwork within an organization, when all the problems pertaining to the manufacturing program are explained and understood by the employes.

Operation of the System

Besides the general superintendent, two men are employed to keep the system running. One is the production supervisor, who makes every effort to increase the productive hours. The other is the employment manager and time-keeper, who acts as a clearing house for the hours spent both in productive and non-productive work, and who, in addition, is directly responsible for holding down the non-productive hours. The employment manager, of course, has a complete record of all men employed in the plant. If a foreman in a given department finds that he will be short of work for a certain number of men within a few days, he notifies the employment manager, who then transfers these men to some maintenance work that may have been held up for the time being but with which it may seem advisable to go ahead, employing the men temporarily idle. Should there be no non-productive work to be done, it will be necessary to reduce the force. However, one of the objects of the system of transferring men from productive to non-productive work is to keep the men permanently employed as long as possible, giving them a steady job in the shop, even though they have to do a variety of work in the course of their employment.

Reports on which the Chart is Based

Each day a shop labor report is prepared by the two men who have charge of the productive and non-productive labor, respectively, and this report is added to the records of the employment manager from which the chart shown in Fig. 1 is constructed. This shop labor report is arranged as shown in Fig. 2. It gives the number of hours spent on productive work, on standard machinery orders and special orders, and the number of non-productive hours spent on maintenance and equipment, experimental work, etc.

Shop Labor Report								
Description	Daily Time Entries							Total for Week
Sales Orders								
Special Orders								
Stock Lots								
Total Productive Hours								
Maintenance & Equipment								
Machine Shop								
Foundry								
Pattern Shop								
Experimental								
Stores and Traffic								
Watchman & Supervision								
Total Non-productive Hours								
Number of Men Employed								

Fig. 2. Daily Shop Labor Report of Productive and Non-productive Hours, used in laying out Chart shown in Fig. 1

Record of Productive and Non-productive Men in the Shop

A record of the number of productive and non-productive men in the shop is kept by the employment manager on a chart which shows the plan of the shop, as indicated in Fig. 3. Each circle indicates a productive man, and each black dot a non-productive man. A dot within a circle indicates a working foreman. The dots and circles are not put in with ink but with crayon, so that they can be easily removed and replaced, and in this way a graphic index of the number of productive and non-productive men in every department is always before the eyes of the general superintendent, the production supervisor, and the employment manager.

Transferring the Men from One Job to Another

The employment manager keeps a list of all the machines and occupations within the plant, which gives the names of the men capable of performing the work under each head. This list is known as a key sheet, a sample of which is shown in the accompanying table. From this sheet it can be quickly determined which men are capable of operating several machines, so that when work on one machine runs out, they can be transferred to a job that is waiting to be done on some other machine. In this way it is possible to run the shop efficiently with a greatly reduced force, and to retain men capable of operating a number of different machines so that all the required work can be handled without hiring a great number of men that are specialists on one machine only. The key sheet helps to solve the problem of operating a plant with a small force of men during a period of depression.

Every plant would have to devise some modifications in a system of this kind to suit its peculiar conditions, but it is believed that the outline given will suggest to the managers of machine shops in general how an effective control may be established to prevent the overhead due to unproductive labor from becoming too large during times of depression. The key sheet also indicates how, by employing not more than, say, twenty-five men, it is possible to fill the jobs for which eighty-five men would normally be required. It is evident that such a key sheet is very valuable in determining which men should be laid off in case there is not enough work to be done. The men who have the best all-around experience would naturally be kept, and those that could not be transferred readily from one machine or job to another would have to be dispensed with first. The details of the system can be readily worked out for each shop according to the local conditions. No attempt has been made to explain anything but general principles. At this time, when so many plants are operating on a reduced schedule, an idea such as outlined should prove especially valuable. It is not a mere theory, but has proved its applicability.

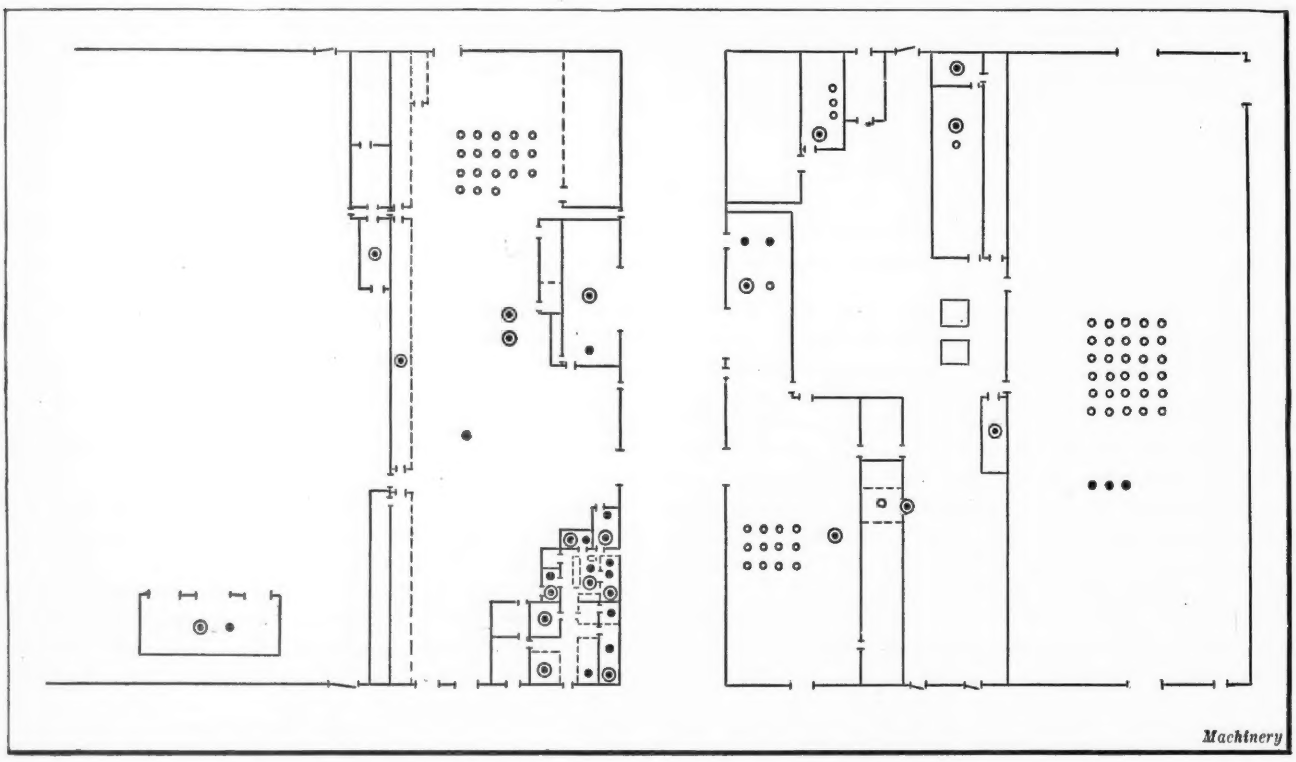


Fig. 3. Lay-out showing the Disposal of Productive and Non-productive Labor about the Plant

KEY SHEET SHOWING DIFFERENT JOBS WHICH THE VARIOUS EMPLOYES CAN HANDLE

Vertical Boring Mills
- Brown
- Johnson
- R. Williams

Keyseaters
- Smith
- Olsen
- Martin

Small Lathes
- Thurston
- Wilson
- MacIntosh
- Wilcox
- Hoover

Large Lathes
- R. Williams
- Brown

Roughing Lathes
- Martin
- Johnson
- Brown

Toolmakers
- MacIntosh
- Wilcox
- Cooper

Turret Lathes
- Hoover
- R. Williams

Grinding Machines
- Wilson
- Cooper
- Thurston
- MacIntosh

Hydraulic Presses
- Connor
- Booth

Milling Machines
- Wilcox
- Green
- Jones
- Wilson

Gear-cutters
- Green
- Jones
- Cooper

Bench Vises
- Cooper
- Wilcox
- Thurston
- MacIntosh

Assemblers
- Jones
- Johnson
- Cooper
- Smith
- Connor
- Booth
- J. Williams
- Hoover

Planers
- Olsen
- Martin
- J. Williams
- Johnson
- Smith

Shapers
- J. Williams
- Olsen
- Smith

Horizontal Boring Mills
- Green
- Jones

Drilling Machines
- Johnson
- R. Williams
- Brown

Sweeper
- Cohen

Casting Cleaners
- Jones
- Riley

Repair Workmen
- Booth
- Connor
- Bradley
- Smith

Work Distributors
- Hogan
- Riley
- Bradley

Carpenters
- Klein
- Dixon

Oilers
- Hogan
- Cohen

Electricians
- Hewitt
- Lynch

Painters
- Dixon
- Klein

Firemen
- Bradley
- Riley
- Hogan
- Cohen

Engineers
- Lynch
- Hewitt

Packers
- Klein
- Dixon

....
....

COUNTERBORING ATTACHMENT

By D. A. NEVIN

Seventy-five thousand brass parts like the one shown at *A* in the illustration were required to have the 0.437-inch hole counterbored or burred to a square bottom and sized concentric with the outside diameter. This could not be done economically on the automatic screw machine employed for the preceding operations, because of the loss of time resulting from the slow feed for which the automatic machine was set, and the necessity for frequent sharpening of the counterbore. Rechucking in the hand screw machine was undesirable, as it would tie up a high production machine on a comparatively simple job which required the use of but one tool. Also the amount of unnecessary floor space which would thus be devoted to this operation, and the inaccuracy which would probably result from the use of a counterbore held in the turret without a pilot were also factors to be considered.

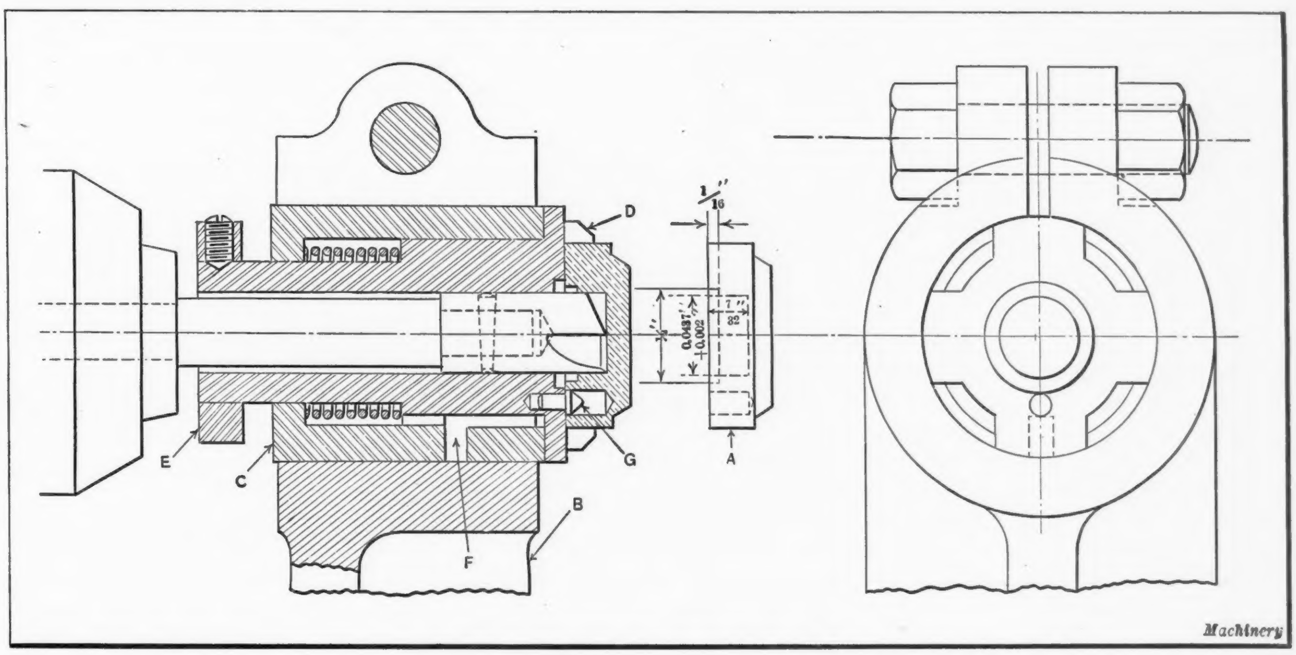
There were several small lathe heads in the store-room which had been used a number of times for tapping and burring. One of these heads was mounted on the bench with the chuck facing the operator and the counterboring attachment added as shown. The bracket *B* is attached to the lathe head and carries the bearing *C*. The spring-operated work-holder *D* is retained in bearing *C* by the collar *E*. Part *D* is keyed to bearing *C* by the key *F*, and the work is driven by the pin *G*.

This and other similar jobs were performed very rapidly by the use of the attachment, as the work is simply placed in the pocket and pushed against the cutter with the thumb. In the sectional view the work is shown in position with the counterbore or cutter at the bottom of the cut. There is probably a considerable amount of hand screw machine work in various factories that could be performed with this device. For general use, it would be necessary to employ interchangeable work-holders, and provide longitudinal adjustment for stop-collar *E*.

* * *

FOUNDRYMEN'S CONVENTION

Announcement has been made that the annual convention and exhibit of the American Foundrymen's Association which was scheduled to be held during the week of April 24 in Cleveland is to be held instead in Rochester, N. Y., from June 5 to 9. All activities of the association will be centered at Exposition Park, which is located a mile and a half from the center of the city.



Counterboring Attachment for Lathe Head

Price and the Machine Tool Salesman

By a Machine Tool Sales Manager

EVEN in the best of times most salesmen are somewhat reticent when they must talk price. They will talk about their product ardently and demonstrate it enthusiastically, until they create an interest and the prospective customer begins to view the article with an eye to its possession. When he wishes to learn the consideration necessary to possess it, the tone of the salesman often changes from one of aggression to one of hesitation. This change frequently makes the prospective customer feel that while the salesman has confidence in the product, he has no confidence in its price.

This lack of confidence is sometimes expressed as well as implied. Recently a buyer needed a collet for a machine previously purchased. When he asked the salesman the price of the collet, he replied: "I am almost ashamed to tell you; it is $11." The collet was not purchased—not at that time.

The salesman's reason for his attitude on price may be that he wishes his customer to notice that he is looking out for the customer's interest. If machine tool prices are or were at any time exorbitant, this would be a commendable attitude on the part of the salesman, but machine tool prices are not high—a fact that may easily be proved by comparative figures—and for the salesman to intimate this in any way borders on misrepresentation. It also creates a misconception in the mind of the buyer that sooner or later must be corrected.

The Salesman's Attitude toward Price

The price of every article is always a factor in its sale, but at no time should this be the sole factor. It is not good salesmanship to dwell too much on the price or even to quote it before explaining the value of the machine itself. On the other hand, there is no reason why the salesman should fear to talk price. Price is a feature of the product. It is so related to the quality of the product that any salesman should feel free to speak of it in bold-face type instead of whispering it in parentheses.

Some machine tool salesmen avoid quoting a price at the time of an interview and state that they will make a formal quotation. This puts too small a value on the importance of price and postpones a decision on the part of the buyer. It is human nature to procrastinate in the spending of money (at least for useful purposes). The salesman generally is not present when the formal proposal is studied, and he has no opportunity to answer questions relative to price. Simply stated, the salesman puts up a fight for the mechanical features of the machine and runs away to let the price shift for itself.

The Relation of Price to Output

In most products there has been a sad lack of stability of price that has caused buyers to be reluctant in placing orders. In the machine tool industry there is no just basis for hesitancy. It is one of the salesman's problems, however, to bring this phase before the buyer in its true light, and to explain the conditions to the customer. Back of every machine tool there is usually some definite proof that may be presented to show the buyer that the price is a reasonable one—not to say a favorable one.

The builder of a production machine tool recently decided to talk to his prospects in terms of output only. Instead of merely stating that the price of the equipment is so much, he also quotes the cost of the operation per piece. The cost of the equipment—the "cost of ownership"—was figured at 6 per cent interest on the original outlay, with depreciation at the rate of 10 per cent per year. Two thousand production hours in a year were assumed. The interest and depreciation divided by 2000 represents the cost of the machine per production hour. Then there are the items of overhead, aside from the interest on the investment and depreciation —such items as rent, light, heat, power, and upkeep. These miscellaneous items were assumed and added to the "cost of ownership." This particular concern allows 30 cents per hour for the miscellaneous items per machine. A $3000 machine on this basis would equal cost, in total, 54 cents per hour. To this cost is added the operator's rate, and this sum, divided by the production per hour, gives the cost per piece.

The whole problem may be expressed by the formula:

$$x = \frac{(A + B) \div C + D + E}{F}$$

in which

x = cost of production per piece, in dollars;
A = interest on investment (6 per cent of cost of equipment);
B = depreciation (10 per cent of cost of equipment);
C = production hours per year (assume 2000);
D = cost of overhead per production hour, in dollars;
E = operator's rate per hour, in dollars; and
F = number of pieces produced per hour.

This method of arriving at the cost per piece may seem somewhat roundabout, but it is more effective than merely assuming a fixed rate per hour, because it shows what items the salesman has taken into consideration in arriving at the cost per piece. Also, the methods of computing shop costs vary widely and are understood often only by the auditor or the cost department, and these departments ordinarily are not consulted in the selection of new equipment.

Another way of justifying the price of machine tools is by the use of comparative figures. Take the composite price of 327 commodities as published by the United States Department of Labor, and compare this with the price of machine tools, in 1914 and in 1922. This comparison will show that machine tools have closely followed the general price curve, and the salesman can prove that any delay in the purchase of a machine tool is unwarranted. Besides, there have been improvements in design and workmanship in most machine tools, and the price will never be as low as before such improvements were made.

Another comparison that is worth while is the relative prices of machine tools and pig iron. Beginning with 1915, and assuming that pig iron and machine tools then had a definite relation in price, it can be shown by a chart that during the years 1917, 1918, and 1920 pig iron rose to a much higher level than machine tools, while in 1919 the two followed closely together, and in 1921 both showed the same downward trend. Pig iron, on account of the conditions, fell somewhat more rapidly, but recovered, while machine tools show a steady decline commensurate with the reductions in raw materials and wages.

Improvement in Quality and its Relation to Price

An example of the effect of improvements on price recently came to the writer's attention. A machine tool manufacturer who formerly used cast iron and soft steel gears is now using heat-treated steel gears that cost five times as much to produce. Such great changes should be pointed out

to the buyers of machine tools in order to explain to them thoroughly the reason why improved quality must demand a higher price.

It is doubtful if any machine tool salesman who studies the problem of manufacturing costs can come to any other conclusion than that machine tool prices today are low in proportion to prices of most other manufactured products. When he has thoroughly studied the subject and come to this conclusion, he is prepared to speak authoritatively on the price question. He may even come to share the opinion of many manufacturers in the machine tool field that some prices of machine tools are now too low and that renewed activity will bring about increases. At this point his real work today begins—to prove and to transmit to the buyers of machine tools the information that he has gathered as to machine tool prices. Armed with the actual facts in the case, he need have no hesitancy on the question of price when making a sale.

* * *

STRAIGHT PIPE THREADS

By J. R. SHEPPARD

Referring to the article on straight pipe threads, appearing on page 492 of February MACHINERY, the writer offers the following additional information:

When hydraulic pressures of 2500 pounds per square inch and over are used, the best practice demands the use of straight threads. In this case a double extra heavy pipe is used, and the gasket placed between the ends of the pipes. The flanges then act simply as connections to hold the ends of the pipes together, the pipe protruding through one flange, while the other flange is counterbored to form a pocket that confines the gasket. With this arrangement, there is only one joint; whereas, if taper threads were used, there would be three joints for each flange connection. The same is also true for plugs for these high pressures, straight pipe threads being used and the joint made with a gasket at the bottom of the plug.

* * *

THE FOREIGN MARKETS FOR MACHINERY

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce has issued a review on the expanding markets for machinery, pointing out that while the flow toward Europe represents a smaller percentage than formerly, the demand in certain other sections is rapidly rising. While Asia absorbed only 7.4 per cent of the American machinery exports in 1910, this market absorbed about 25 per cent in 1921. The statistics indicate that the markets that have shown the greatest activity in 1921, compared with pre-war years, are to be found in British India, Dutch East Indies, Japan, China, Mexico, Argentina, Brazil, and Cuba. Considering the machinery field as a whole, it appears that there is reason to be optimistic regarding the machinery markets in these countries as well as in Australia and South Africa. In certain lines of machinery, these markets have absorbed much of the exports that normally would have gone to Europe.

* * *

A joint meeting of the Virginia sections of the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Institute of Electrical Engineers was held at the Virginia Polytechnic Institute at Blacksburg, Va., February 17 and 18. The subjects dealt with pertained particularly to the distribution and production of coal, and papers were read on the transportation of coal, the electrification of railroads, and coal combustion. A visit was made to the power station at Bluestone Junction, where experiments are now being made with pulverized coal fuel equipment, and a trip was also made to Pocahontas, Va., to see the coal mining operations in this well-known mining region.

CHAMFERING RING BEVEL GEARS

The chamfering of the outer edges of bevel gear teeth is sometimes an advantage, but in doing this work, it is often difficult to produce a neat-looking job. As the result of some experimenting, the Illinois Tool Works of Chicago, Ill., have made successful application of the hobbing process for this purpose. A special hob has been developed, as illustrated in Fig. 1, where a No. 18 Gould & Eberhardt hobbing machine is shown engaged in beveling the teeth of a spiral bevel ring gear. A section of this gear with a number of teeth is

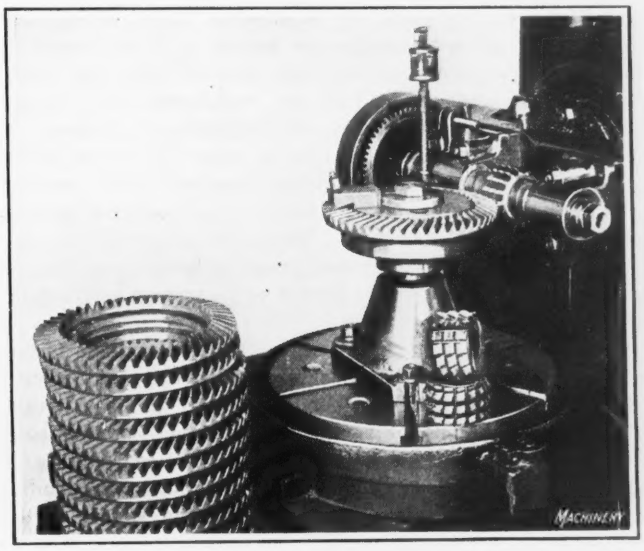


Fig. 1. Chamfering Gear Teeth on the Hobbing Machine by the Use of a Special Hob

shown in Fig. 2, from which it will be noticed that the work presents a neat appearance and that all teeth are uniform.

Owing to the continuous generating action of the hobbing process, and to the fact that very little stock is removed in the operation, the work may be performed with considerable speed. For example, in a recent trial, ring bevel gears having fifty-five teeth were chamfered in forty-five seconds each, floor to floor. It is believed that this performance can be duplicated by using these special hobs with any suitable hobbing machine. It is necessary to provide a work-holder having a quick-releasing feature, by means of which the ring gears may be located accurately and held securely, and this is the only extra equipment required for handling work of this kind. The hobs, except in the very coarse pitches, are

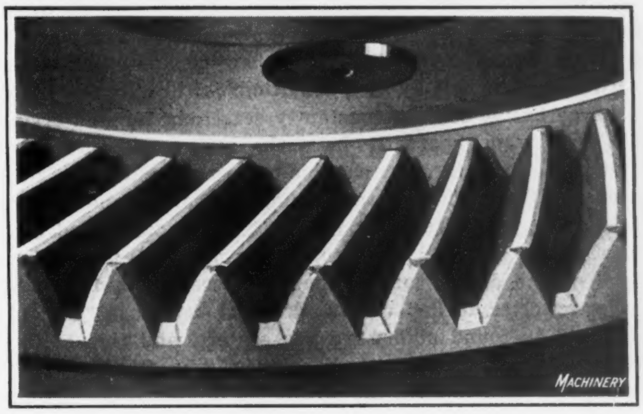


Fig. 2. Section of a Ring Bevel Gear showing Teeth which have been chamfered

of standard dimensions, that is, 3½ inches in diameter and 3 inches long, as this size is best suited for the purpose. Hobs of this length allow for shifting into several positions to make use of all the teeth before they need to be removed for regrinding. The life of a hob used for this work will extend over a long period of time, because it is only necessary to sharpen the hobs at intervals of several days.

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BALL BEARINGS FOR LINESHAFTS

It has long been claimed by manufacturers of ball and roller bearings that considerable saving in power would result from the use of such bearings for lineshafts, and recent experiments made by one of the well-known ball bearing manufacturers have demonstrated the justice of these claims. The experiments referred to were made in textile mills, where it was found that when the lineshafts were running idle the power saving due to the use of ball bearings amounted to from 9 to 25 per cent. When the spinning machines were running, the load on the lineshaft being fully thrown on, the saving amounted to from 6 to 7 per cent of the total load.

The saving of so comparatively small a percentage is not a small item in dollars and cents. One of the installations, where the experiments were conducted, paid for itself within a year on account of the saving in power, and another paid for itself in six and one-half months. With coal selling at high figures these power savings are well worth while; and, generally speaking, after the first year the saving is all "velvet."

The economy resulting from the use of ball and roller bearings for lineshafts is applicable to small installations as well as large ones. In a small factory where the power cost averaged between $36 and $40 a month, and $200 was spent on installing ball bearings, the power cost was reduced to from $23 to $26 a month. In other words, the saving in a single month was sufficient to pay a large annual interest on the first cost of the bearings, or, figured in another way, the entire cost of the installation was repaid in about eight months.

* * *

TRAINING FUTURE EXECUTIVES

The president of a large locomotive company recently said that quite a number of executive positions in his organization remain vacant because of the difficulty of finding men capable of filling them satisfactorily. Had young men of the requisite ability and energy been trained in time to fill the higher positions as the opportunities arose, capable men would have been ready. But the management is by no means entirely responsible for this condition, for usually the heads of large businesses are constantly searching for and trying out men who apparently have the making of future executives. Those they try out line up from mediocre to fairly good. Seldom is a star executive developed. In one concern more than a hundred outside young men were looked over in a careful but vain effort to find an office executive. The head of one of our largest concerns recently said that he never expected to find one hundred per cent men. He felt lucky if he found eighty-five per centers, and this is true generally, especially among shop men, who are less likely than office men to have the advantage of education in their youth.

It is usually difficult to obtain from the outside a thoroughly trained and satisfactory executive. Such men lack the necessary familiarity with essential details of the business, and they must be engaged for a long period at high salaries, which they are not always worth. The ideal method is to train men taken from the organization, because those who have worked for a concern for a period of years usually possess a more thorough knowledge of its product, policies, methods and needs than an outsider.

A large manufacturer in the Middle West is at present endeavoring to develop executives by means of a series of meetings and studies which bring the plant superintendent and a number of the other executive heads of the company in close contact with the foremen and others in minor executive positions. During these conferences such subjects as principles of inspection, production management, time and motion study, wage payment systems, duties of foremen and other minor executives, and methods of handling men efficiently, are brought up. In this way the management is afforded an opportunity to form a sufficient estimate of the judgment and ability of some of the subordinates to warrant trying them out further.

* * *

MECHANICAL AND MARKETING PROBLEMS

The head of a large machine tool plant, when recently asked what in his opinion were the most important questions for machine tool builders to consider during present conditions said that they should devote their time principally to three distinct problems:

First, they should develop the design of their machines to the highest point of productive efficiency, profiting by their experience during the high productive period since 1915. If they do not feel warranted in spending money on actual development and experimental work, they should at least give all the thought possible to working out designs carefully on paper, so that the resulting improvements can be quickly turned into concrete form when the market warrants.

Second, machine tool builders should study the methods used in their own plants with an eye to reducing manufacturing costs and to improving the accuracy of their product. Machine tool builders could often profit, this manufacturer said, by applying in their own plants methods of interchangeable manufacturing which some of them have developed for their customers. By applying the unit system of design and construction to a line of machine tools, it would frequently be possible to produce many parts of the machine in greater quantities and at a reduced cost.

Third, they should not lose sight of the possibilities of foreign trade in non-European countries. It is not likely that Europe will buy many machine tools for several years; but there is a constantly increasing market in other parts of the world. Japan, China and India, for example, imported, in value, more metal-working machinery in 1918 than England and France combined imported in 1910, and almost as large an amount as England, France, and Germany combined imported from the United States in 1909. In 1919 and 1920 the imports of metal-working machinery into Asia were greater than in 1918, and it is expected from present figures that in 1921 the entire value of our metal-working machinery going to Asia will be nearly $6,000,000—three times the value of the metal-working machinery sold to England and France in 1910. Australia also offers a growing market, and the same is true of South America. These markets may offset the important pre-war European markets, now dormant, and competition with England and Germany will undoubtedly be keen in all of them. For that very reason our machine tool manufacturers should study them carefully and prepare themselves to meet the competition there.

The Supply of Used Machine Tools

DURING the war period, machine tools were built in much larger quantities than would have been required for the normal needs of the country in peace time. For much of this machinery there appears to be no immediate use; hence it is generally believed that large quantities of such machinery are for sale—a quantity vastly greater than was normally on the market in pre-war years. Manufacturers as well as users of machine tools share this belief, which is a logical inference from past and present conditions. Nevertheless, there were many indications that the supply of used machinery was not materially greater than in pre-war years, and MACHINERY undertook to get the facts from the War and Navy Departments and from dealers in used machinery, and others, throughout the country. The results we are now able to place before the machine-building industry and the users of machine tools in other fields.

It is generally believed by manufacturers as well as buyers of machine tools that there are very large stocks of used metal-working machinery which will seriously affect the market for new machine tools. MACHINERY has investigated the situation, and the results are given in the present article. There is no substantial foundation for the belief that large stocks of used machinery are available. Neither the War and Navy Departments nor the dealers in used machinery have any abnormally large stocks of such machinery.

The Effect of the War

While enormous quantities of machine tools were built during the war, thousands of machine tools were used up during that period. Machines of older types considered adequate up to that time were found useless for the hard service required by war conditions, so that while there was a tremendous increase in the number of machine tools built, there was also a great increase in the number of machine tools scrapped; and at the end of the war, many of the machines bought specifically for the manufacture of munitions and other war supplies had been used so severely that they were not marketable as used machinery. An instance may be cited: One of the largest plants in the country advertised for sale early in 1919 a large quantity of machine tools used in its munitions plants, but the prospective buyers found them so far below par that most of them had to go to the scrap heap.

Furthermore, much of the machinery built at that time was special in nature, and while it added to the curve that showed an increase in machine tool production, it did not add to the available supply of machine tools for general purposes. We have seen several hundred shell turning lathes in the yards of a large plant ready to be broken up for scrap, there being no further use for them; and recently the Government offered for sale some fifty lathes of a well-known make built for a special purpose, having neither lead-screws nor carriages. It is easy to imagine how much sale there will be for lathes of this kind in the used machinery market.

Present Government Stocks

The War and Navy Departments have nothing like the big stocks of machine tools on hand with which they are generally credited. Most of the machinery to be disposed of by these departments, where the machines are of general applicability, has been sold. Machines built for special purposes, and obsolete machines for which there is no market, are still available, although many have been scrapped, especially by the Navy Department.

In addition to the machine tools sold by the War Department in this country since the war, large quantities were sold abroad, and a considerable percentage was acquired by the schools and colleges under the provisions of the Caldwell Act. To be sure, there are still War Department machine tools on the market, and additional ones will doubtless be offered for sale, but the quantity is not such as to warrant any apprehension on the part of the machine tool industry.

The Navy Department's records do not show any considerable quantity of machine tools for the market. Such machines as turning and boring lathes, and special single-purpose tools, which were required during the war period, have been absorbed by the various naval shops, or otherwise disposed of. A considerable quantity has been scrapped because there was nothing else to do with them. It is stated by the Navy Department that machine tool manufacturers need not be apprehensive about any large offerings of machine tools by the Navy.

Stocks of Dealers in Used Machine Tools

A canvass of the used-machine tool trade shows that most of the leading dealers in used machinery have no larger stocks (by volume) of such machine tools at present than they considered normal in pre-war days. A few have a smaller stock by volume—if not by value—than they carried before the war, and a small percentage have larger stocks—two or three considerably larger stocks. There are some exceptions, of course, but the fact is that the dealers, generally, have not stocked up to an extent appreciably exceeding their pre-war supply.

As compared with a year ago, about one-half of the dealers report that they are keeping their stocks at about the same level. Most of the remainder report smaller stocks, and only a few report larger stocks than a year ago. It is also found that the dealers have difficulty at the present time in obtaining good first-class used machinery to add to their stock. What is offered are mainly obsolete machines or those for which there is not a ready sale.

Machine Tools Available in the Used Machine Tool Market

Referring specifically to different classes of machine tools, it may be stated that while there is a fair quantity of production lathes in the used machinery market, there is a scarcity of good precision lathes. Some dealers state that it is almost impossible to buy lathes of certain well-known makes known for their quality. Only in the centers where there were an unusually large number of tool and contract shops, some of which have gone out of business, are used machines of this type available. There are but few heavy lathes available except those having unusual bed dimensions, in which case some are for sale, with no buyers, because the machines were designed for special purposes, such as for boring gun tubes. There is a fair quantity of turret lathes on the market, but few machines of the best known makes. The same is true of the smaller sizes of automatic screw machines—in fact there is a great scarcity of the best makes; but of larger sizes of automatics there is a fair quantity available.

In the milling machine field, there is a scarcity of universal machines, a fair quantity of plain machines, and a considerable number of Lincoln and semi-automatic milling machines. The supply of planers is practically normal. There

are always used planers for sale, but the number today is not excessive.

In the drilling machine field, the greatest supply is in the multiple-spindle type. There is a fair number of radials offered, but comparatively few single-spindle upright machines. The supply of shapers is small. In the grinding machine field, there is a scarcity of universal and surface grinders, with a fair quantity of plain grinding machines being offered.

The best makes of vertical boring mills are scarce—in fact, it would probably be impossible to obtain certain sizes of some specific makes. This is also true of horizontal boring machines—few machines of the well-known makes are available. The supply of gear-cutting machines is not above normal, and buyers have found it difficult to obtain specific makes in the local markets. Some machines may be available elsewhere, but it is not easy to bring the buyer and seller together.

In the press field, there is a large quantity of presses built especially for war work—for the drawing of cartridge cases, for example. But there is no surplus of small presses and comparatively few toggle presses are available.

Briefly summarized, there are few machines in the used machinery market of the best grade of small and medium sized types. Much of the machinery in the hands of the dealers is special, and some is obsolete; and sooner or later some of this will be scrapped as there is no market for it.

Opinions of Dealers in the Used Machinery Field

The opinions of a number of the leading dealers in the used machinery field will prove of interest. A well-known dealer in the Middle West makes the following statement: "We find a scarcity of good tools that can be purchased at reasonable prices and feel certain that some of our competitors who are sacrificing their stock to do business will find it very difficult to replace it later on. The average buyer today desires to purchase machine tools and other equipment at a lower price than the average dealer can buy them for, and the owners of good tools that are for sale are holding them at higher prices than the dealer is willing to pay. This condition will lead to a scarcity of good tools in the hands of the dealers and means higher prices later on."

Another dealer in the same territory says: "We have looked at a great deal of machinery that is for sale around the country, but naturally are buying only the desirable machines and only those that we can buy at a price which will enable us to carry such machines for from three to five years and face a further decline in machine tool prices."

It is only from the cities that were exceptionally active in war work that we hear of more than normal quantities of machine tools being available in the used machinery market. A dealer in one of the New England cities, well known for its war activities, says: "The opportunities for securing used machinery are greater than they have been for a number of years, and in our opinion there is more used machinery on the market today than at any time since 1914." This view is the exception, and is explained by local conditions. A similar opinion is given by a dealer in one of the large Middle-Western tool and contract shop centers where many of the tool shops have gone out of business.

A New England dealer believes that there is going to be a fine market in 1922 for good up-to-date, overhauled second-hand machine tools; but he states that at the present time "there are very few good second-hand machines on the market for resale at the proper prices."

In Philadelphia it is found that sales of both new and used machinery are from 15 to 20 per cent better than for last October, and the present outlook is better than it was during the past year.

In Pittsburg the stock of used machinery is no larger, comparatively, than would be considered normal in pre-war years—that is, speaking of volume alone—and the stocks in general are smaller than those of a year ago.

INDUSTRIAL CONDITIONS IN FRANCE

Business conditions in France are not quite so good at present as they have been during the last two or three months, due in part to the recent political changes. Our correspondent writes, however, that the outlook is encouraging, especially in financial circles. One indication of this is the confidence shown on the stock exchanges. If the financial condition improves, there is no doubt that general business conditions will also be favorably affected. It was generally thought that the industrial situation would be greatly affected by troubles due to proposed reductions in wages of miners in the northern part of France, but after several conferences, a satisfactory agreement was reached between the workmen and their employers with the result that the danger is past.

An order for 800 freight cars has recently been placed by the Nord Railroad Co. In addition, the same company has asked for quotations on from 2000 to 2500 passenger cars. An order has also been obtained from Roumania for 50 trolley cars and 50 trailers. Several orders have been placed with manufacturers of nuts and bolts. One order for expansion bolts was accepted at 110 francs per 100 kilograms (about $4.40 per 100 pounds, present exchange). Another order for bolts weighing 85 kilograms (about 190 pounds) per 100, was accepted by a factory in the Ardenne district at 77 francs per 100 kilograms (about $3.10 per 100 pounds). These prices include delivery to a railroad station in the vicinity of Paris. An order for galvanized-steel coopers' tools has been accepted by a company in the Lorraine district at 94 francs per 100 kilograms (about $3.75 per 100 pounds).

Conditions in the bicycle industry continue to be very good, French dealers now being able to compete successfully in France with British manufacturers. However, they are unable to market their product abroad because of the German competition made possible by the low rate of exchange. The competition among foundries is very keen. Simple steel castings averaging 30 kilograms (about 65 pounds) are quoted at 130 francs per 100 kilograms (about $5.20 per 100 pounds).

* * *

SAFETY CENSUS

The National Safety Council is taking a census of the men and women engaged professionally in safety and industrial health activities in all the industries of the United States as well as in public safety work. The council frequently receives requests from firms, municipalities, colleges, and other organizations for help in finding speakers or writers on safety subjects, and the census records will greatly increase the facilities of the council for filling such requests. To assist in obtaining the names of persons engaged in preventing accidents and promoting good health in the machine-building industry, readers of MACHINERY employed in this class of work are requested to communicate with the National Safety Council, 168 N. Michigan Ave., Chicago, Ill., who will supply them with forms to fill out, giving the necessary data.

* * *

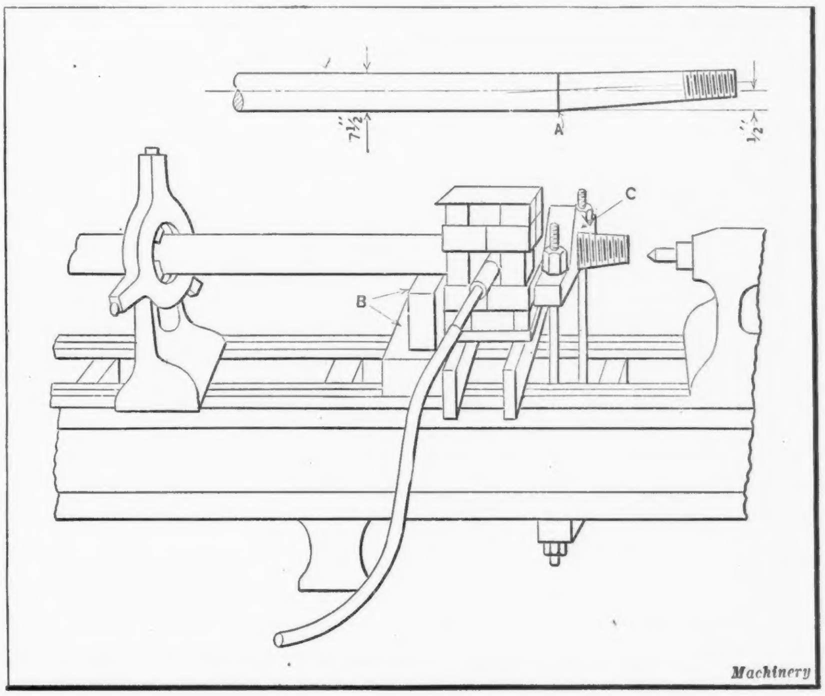
The general depression in Scandinavian financial and industrial life still prevails, and financial experts say that the crisis will be of long duration, according to a communication from Commercial Attaché W. L. Anderson at Copenhagen, Denmark. Scandinavian industries continue to struggle with high production costs, and are operating at a minimum profit. Employers claim that wages must be reduced further before the industries can be put on a competitive basis. Unemployment continues to be a serious problem, and the number of unemployed has increased slightly of late. The Swedish iron and steel production has been reduced to a minimum, the high costs of production resulting in inability to compete with foreign iron and steel products.

USE OF PREHEATING TORCH FOR REPAIR WORK

By J. HARRY CLEMMENCY, Superintendent Repair Shops, Bureau of Water, Philadelphia, Pa.

A great deal has been written on the subject of thermit welding and its usefulness in repair work. Little attention, however, has been given to the use of the preheating torch of the thermit welding outfit as a means of facilitating repair shop work. While the preheating torch is considered as auxiliary equipment, designed primarily to produce conditions favorable to a perfect thermit weld, it has nevertheless proved well adapted for a great variety of work encountered in the repair shops of the Philadelphia Bureau of Water. The following examples of work done in these shops with the aid of the preheating torch will suggest ways in which it can be employed in the average machine shop.

The preheater itself is so simple in construction and so compact that it may readily be moved about to any place where heat is to be applied. In machine shops, especially those engaged in miscellaneous repair work, it is frequently necessary to provide means of applying intense heat to definite points, and the preheater will be found admirably adapted for work of this nature.



Straightening Bent Piston-rod with the Aid of a Preheating Torch

Straightening Piston-rod

An unusual task that illustrates the usefulness of the preheater was the straightening of a 7½-inch steel piston-rod that had received a short bend as a result of meeting with an obstruction in the cylinder of a pumping engine. The bend was at the shoulder point of the tapered end as shown at *A* in the accompanying illustration. The end of the rod was thrown out about ½ inch from the center line as indicated by the somewhat exaggerated view. A careful examination at the point of the bend revealed no trace of a crack or flaw. It was therefore decided to straighten the rod and put it back in service.

Ordinarily there is nothing difficult about straightening a bar of steel 7 or 8 inches in diameter, but when the operation is complicated by the fact that the rod to be straightened is finished and no hammer or sledge blows are permitted, and that it is required to be true when finished, it will be readily apparent that the work presents some difficulties. The success with which the straightening was accomplished was in a large measure due to the use of the preheating torch of the thermit welding outfit. In performing the straightening operation, the rod was held in a heavy 36-inch lathe. One end was placed in the chuck and the other end supported firmly on steel blocks *B* built up from the ways of the lathe at a point just back of the bend. The lathe steadyrest was used to centralize and steady the rod, being placed a foot or two back of the blocking as shown.

A piece of sheet iron was placed under the point of the bend, and upon this was built an improvised furnace of old discarded firebricks. The top of the furnace was covered with a piece of sheet iron. An opening was left in the front of the furnace just below the center of the rod into which the burner of the preheater was introduced. The heavy V-shaped clamp *C* was placed over the end of the rod, and two stud bolts passed through the ends of the clamp and down between the shears of the lathe through a heavy cross-clamp placed under the lathe bed. When the torch was lit, the flame, being confined by the firebricks, swept around the rod at the proper point and thus speedily heated it to the required temperature. Wrenches were applied simultaneously to the two nuts on the clamp stud bolts. The bent end was thus gradually pulled back to its original position, the center of the tailstock serving as a guide to determine when the work was properly centralized. When the blocking and clamps were removed, it was only necessary to take a very light cut over the tapered portion of the rod in order to insure a perfect fit and alignment. The ease with which this piece of work was handled was due to the fact that the flame of the preheating torch was confined to the right portions of the work.

Use of Preheater in Assembly Room

It would be difficult to describe all the uses to which the preheating torch may be adapted in the assembly department. The possibilities are practically unlimited, and each shop can develop its service in line with its own particular requirements. In the general work of assembling miscellaneous machine parts, the application of heat is often desirable and sometimes necessary. For work of this kind where tight and shrink fits are required the hot clean flame of the preheater will be appreciated when its advantages are fully realized. The flame of the preheater can also be used to advantage as a means of loosening parts that have become cemented together by corrosion. In dismantling old machinery, many cases of this kind are encountered.

Melting Babbitt and Heating Rivets

The preheater is also useful in babbitting work. It has been found that babbitt can be removed from old bearings more rapidly and conveniently with the preheating torch than by any of the methods usually employed. A number of bearing shells are placed in a line over a metal receiver and the flame of the preheater passed from one to the other, thus melting the babbitt linings in a few minutes. When cracks develop in cast-iron cylinders that are to be welded with the acetylene torch, the preheating essential to a good weld can be conveniently done with the preheater.

In one instance where a large number of rivets were to be driven at a considerable distance from a forge, the work was facilitated by arranging a few firebricks on a piece of sheet iron which served as an oil-burning furnace to heat the rivets. By introducing the flame of the preheater into the open side of this furnace sufficient heat was quickly generated to bring the rivets to the required temperature for driving. Kerosene is used for all heating operations done with the preheater, except preheating for thermit welds, in which case gasoline is invariably employed.

Duralumin and Its Use as a Gear Material*

By ROBERT W. DANIELS, Baush Machine Tool Co., Springfield, Mass.

DURALUMIN is an aluminum alloy produced after years of search for a metal combining the lightness of aluminum with the strength and toughness associated with ferrous metals. This condition has been met to a remarkable degree, and the resulting physical characteristics make duralumin a most desirable material for certain kinds of gearing. The commercial manufacture of the metal in this country dates back little more than two years, although it was first made in Germany and developed by A. Wilm and associates, during the years intervening between 1903-1914.

The principal and unusual feature of duralumin is that after it has been hot-, or hot- and cold-worked, it may be further strengthened and toughened from 40 to 50 per cent by heat-treatment. This heat-treatment is somewhat analogous to the heat-treating of alloy steels and consists of quenching at temperatures below the melting point, followed by an aging process. The increased physical properties are not all produced immediately on quenching, but increase during the subsequent aging. In addition to being made in Germany, the manufacture of duralumin was taken up in England by Vickers, Ltd., prior to the war. Its use for structural purposes in connection with aviation brought the material to the attention of the engineering world, and today duralumin is recognized as occupying the same relative position to ordinary aluminum sheets or bars that heat-treated alloy steel does to ordinary carbon steel.

Physical Properties of Duralumin

The strength and toughness of duralumin are comparable with mild steel, and are obtained with a specific gravity of 2.81 as against 7.8 for steel. The melting point is approximately 1210 degrees F., the recalescence point, 970 degrees F., the annealing temperature approximately 680 degrees F., and the coefficient of expansion 0.00001798 per F. degree of temperature. The chemical composition of the alloy varies within the following limits, copper 3 to 5 per cent, magnesium 0.3 to 0.6 per cent, manganese 0.4 to 1 per cent, the remainder being aluminum plus impurities. Small quantities of other metals are sometimes added for certain reasons; for instance, chromium may be added to increase the burnishing qualities of the metal.

In the annealed form duralumin can be drawn, spun, stamped, and formed into a great variety of shapes, similar to brass and mild steel. The physical properties in this state average: Ultimate tensile strength, 25,000 to 35,000 pounds per square inch; yield point, 22,000 to 24,000 pounds per square inch; elongation in 2 inches, 12 to 15 per cent; Brinell hardness, 57; and scleroscope hardness, 11.

Duralumin in its heat-treated form may be slightly shaped or formed and may be bent cold to 180 degrees over a mandrel having a diameter of four times the thickness of the sheet. Its remarkable tensile strength is here combined with its maximum elongation as follows: Ultimate tensile strength, 55,000 to 62,000 pounds per square inch; yield pound, 30,000 to 36,000 pounds per square inch; elongation in 2 inches, 18 to 25 per cent; Brinell hardness, 93 to 100; and scleroscope hardness, 23 to 27. Heat-treated duralumin forgings have similar physical properties. When the sections of forgings are heavy, it is advisable to lower the mininum tensile requirements to 50,000 pounds per square inch. This will cause a proportional increase in elongation.

Heat-treated and hard-rolled duralumin is used where no bending or forming is required. It is a hard, strong, springy metal in this state, and machines and polishes well. Its physical properties in this form average: Ultimate tensile strength, 67,000 to 72,000 pounds per square inch; yield point, 58,000 to 65,000 pounds per square inch; elongation in 2 inches, 3 to 8 per cent; Brinell hardness, 130 to 140; and scleroscope hardness, 39 to 42.

General Characteristics

Duralumin is unaffected by mercury, is non-magnetic, withstands atmospheric influences, and offers unusual resistance to sea and fresh waters. It is only slightly affected by numerous chemicals which readily corrode other metals and alloys and does not tarnish in the presence of sulphurated hydrogen. It takes a polish equal to that of nickel-plated articles and remains bright without cleaning longer than plated or silvered articles. It is an ideal substitute for aluminum, German silver, brass, copper, and steel when lightness combined with strength is required. Although duralumin is only one-third the weight of steel, heat-treated duralumin forgings approximate mild steel forgings in strength, so that wherever weight is a deciding factor, duralumin is satisfactory for most shapes made by hot-working or forging. Duralumin forgings are especially desirable for reciprocating or moving parts where the inertia due to their own weight, forms a large part of the total stress. Duralumin machines easily and, as it does not corrode, is suitable for use in many places where weight is not the prime essential.

Process of Manufacture

The manufacture of duralumin is somewhat analogous to that of steel and is carried on in the following sequence:

1. Manufacture of the alloy from its aluminum base.
2. Casting the ingot.
3. Hot-rolling or cogging in blooms, billets, or slabs.
4. Hot- or cold-working to the final shape.
5. Heat-treating.

The ingots are poured at as low a temperature as practicable, that is, just enough above the melting point to fill the mold and prevent cold shuts. They are then either hot-rolled or cogged into slabs, blooms or billets, similar to the manner of working steel. This hot working is done at a temperature of from 840 to 900 degrees F. Such low temperatures cannot be judged by color, and it is therefore necessary to use pyrometers in heating the metal previous to working it.

The final rolling or forging may be done hot or cold according to the character of the work being handled or the shape it is desired to produce. The hot- or cold-worked metal in its final shape shows greatly improved physical properties over the cast ingot, but the full development of its qualities is obtained only by a specific heat-treatment. To obtain this heat-treatment, the metal is heated to a temperature of from 930 to 970 degrees F. for a period of time depending upon the section of the piece, and then immediately quenched. The heating and quenching improve the physical qualities of the metal, but the maximum results are obtained only by a subsequent aging. During the aging period, which takes from one to five days, the tensile strength, hardness, and elongation of the alloy increase markedly. Aging is sometimes accelerated by placing the metal in a hot water bath of a temperature up to 212 degrees F. or in

*Abstract of a paper read before the American Gear Manufacturers Association

a hot room. The heat-treatment develops properties which have not been obtained in a like degree in any other aluminum alloy. The cast ingot has a tensile strength of from 28,000 to 32,000 pounds per square inch, and an elongation of from 1 to 3 per cent.

When it is required to put a considerable amount of work upon duralumin in its finished state, it is often found necessary to anneal the sheets between operations in precisely the same manner as with other metals. This annealing should be done at about 660 degrees F. If several drawing operations are to be performed, it may be necessary to anneal the metal between such operations. Annealed duralumin can be heat-treated and the maximum physical properties obtained, no matter what shape or form the metal may be reduced to. Conversely, heat-treated duralumin may be annealed. Duralumin may be cold-worked after heat-treatment and aging. This operation produces a hard smooth finish, and materially increases the tensile strength of the metal at the expense of elongation.

Use as a Gear Material

For a given section, the weight of duralumin is about one-third that of bronze, and for parts produced in large quantities, duralumin is the cheaper of the two metals. Therefore duralumin is an ideal material for worm-wheels, and especially those used in automobile constructions, provided the wearing qualities are satisfactory. The tensile strength and relatively high elastic limit insure a superior tooth strength, while the homogeneous structure and uniform hardness of heat-treated duralumin forgings insure entire freedom from hard spots, porosity and spongy areas so common in bronze castings, which entail not only a machine loss but uneven tooth wear in service. The data from various laboratory tests on bronze and duralumin worm-wheels may be summarized by saying that tests destructive to duralumin worm-wheels were also destructive to those made of bronze.

When duralumin and hardened steel are run together the results are always good. An example of this application was shown by having duralumin connecting-rods running direct on the wrist-pins. A better life was obtained at this point than with conventional bronze-bushed rods of equal bearing area. Comparative tests of bearings made from duralumin and bearings made from babbitt show that for shaft speeds exceeding 700 revolutions per minute and loads over 200 pounds per square inch, duralumin bearings developed less friction, remained cooler and showed practically no loss in weight under most severe conditions. For lower bearing pressure and slower speeds, babbitt metal was superior.

An important condition was revealed in tests with worm-wheels made of duralumin, by examining the lubricant used. After long tests with bronze wheels where the oil has not been changed, the oil is found to contain particles of bronze in suspension. This condition is sometimes very marked and is of importance not only as indicating tooth wear but as showing the deterioration of the lubricating value of the oil. Oil heavily charged with metallic particles acts more like an abrasive and less like a lubricant, and therefore is an important factor in the wear of automobile gearing, where the oil is infrequently renewed. When duralumin wheels were used, the charging of the oil with metallic particles was practically negligible.

The different tests point to excellent life for duralumin worm-wheels, unless the wheels are roughened by lack of lubrication or too high a tooth pressure which will injure or destroy any worm-gearing.

The same qualities that make duralumin a desirable material for worm-wheels also make this material valuable for other types of gears. It is suitable for this class of work when the pressures are sufficiently within its elastic limit of 30,000 pounds. Where this condition is met, and weight and quietness are desirable, duralumin will satisfactorily replace iron, steel, brass, fiber, fabrics, etc. Where duralumin can be run with steel rather than against itself the best results are obtained. An example of this application is found in the timing gear trains of automobile motors where both long life and quietness are essential. Helical duralumin gears alternated with steel gears have been very successful in service. That duralumin gears when meshed with steel gears are quiet may seem somewhat paradoxical since, when struck, all duralumin forgings are resonant. However, this condition obtains and is undoubtedly due to the difference in pitch of the sound vibrations of steel and duralumin.

* * *

PRICES OF MACHINE TOOLS

It is apparent that there has been some hesitancy in the buying of machine tools due to lack of confidence in the stability of machine tool prices. While it is true that a large number of shops are not in operation to a sufficient degree to require new machinery, there are many that should buy to replace inefficient equipment and reduce their production costs so that they can successfully enter into competition with other plants having more modern machine tool equipment especially suited to their needs.

One of the well-known firms in the turret lathe field has carefully analyzed future labor and raw material costs, and has announced that its prices have been brought down to such a basis that there can be no further reductions. In order to indicate the reductions that have taken place, this company has published in its advertising the peak prices and the present-day prices for its turret lathes. This comparison indicates that machines costing, at peak prices, $3900 have been reduced to $2450; those costing $2690, to $1695; and the smallest size, costing $590, are now being priced at $370. The reductions on other machines in the line are in similar proportions, and it is not necessary to quote them all in detail.

The machine tool builders at present are divided into two groups—often through force of circumstance. One group comprises those who are liquidating their inventories at prices either yielding no profit at all or a loss, and who are taking orders for equipment at less than either present or expected future costs would justify. The other group includes those who are anticipating future costs in such a manner as to reduce their prices immediately to a final level to which they will adhere. The company whose announcement relating to final price reductions is appearing at present in the trade journals belongs in the latter class.

There is no reason why machine tool builders should sell their equipment below cost, virtually giving away part of it to the users. The user should be and is willing to pay for value received, provided he really needs the equipment and the industry as a whole maintains a consistent attitude of obtaining a reasonable price for its product. After all, the buyer of equipment is not pursuing the wisest course if he buys machinery merely because it is cheap. His main purpose should be to obtain productive efficiency. Taking the machine tool industry as a whole, there are no additional sales made because prices are at or below cost. Some one concern may obtain an order in preference to another company because it is selling at a very low figure, but the industry as a whole suffers if it does not receive a fair return for its products. And ultimately the machine tool buyer suffers also, because there will be less advance in the development of production machinery.

The machine tool builders should do all in their power to increase the confidence of the buyer in their product, both as to its quality, its capacity for production work, and the stability of its price. The best service that could be rendered the entire industry would be for machine tool builders in general to analyze their costs in the manner indicated, and definitely announce that they are quoting bed-rock prices. A stable market is always the best market, not only for the buyer but also for the seller.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, February 11

CONDITIONS in all branches of trade show a slight improvement, with the possible exception of the shipbuilding industry. In the latter case the idle time is being utilized in investigating the merits of new engine design and the suitability of the application for marine propulsion purposes, especially in connection with internal combustion engines of the Diesel type.

Conditions in the Automobile Industry

Under present conditions the most hopeful field for the machine tool maker is the automobile industry, particularly that branch which is engaged in the manufacture of light cars, and some new equipment is being bought by manufacturers in this line. It will be interesting to note the effect on the automobile industry of the increased value of the pound sterling in the United States, as at present American automobiles are being imported into this country on a smaller scale than for many years. Already certain American cars are being offered at very low prices, and any continued appreciation in the pound value will tend to reduce these prices still further. British makers can hope to improve the home and overseas trade only by building more of the most popular types of cars.

The demand for tractors also appears to be improving, which should, in turn, stimulate the market for machine tools and the necessary manufacturing equipment. The Ford Co. in Cork is reported to have been in the market for such equipment, and since it is located in that part of Ireland where tractors should find a big opening, business prospects are likely to be good as soon as conditions in Ireland become settled. Meantime, a gratifying increase in orders is reported among steel firms who supply the automobile trade.

General Industrial Conditions

In industry generally, buying is still confined to straggling orders sufficient only to meet the needs of the moment. Foundries are becoming busier, but here again the automobile trade is the main cause. One foundry firm has secured an order for 5000 engine crankshafts, and this represents, perhaps, the largest order of this kind that has been placed in this country. There is some improvement in the engineering trades in the Birmingham district, where government orders for bicycles and important inquiries from France for motorcycles are outstanding developments.

Much greater attention is being paid to special tooling equipment, and although this is most noticeable in the automobile industry, other branches of engineering are becoming more alive to the advantages of well planned manufacturing equipment. There are now several firms in the Midlands who specialize on tool production, and these, almost without exception, have orders in hand for complete tool, jig, and fixture equipment, and are running double shifts. In small tools a fair trade is being maintained, but this is understandable, as even with a small proportion of the total capacity of shops occupied, there is a continuous, though meager, consumption of small tools.

In Sheffield, much satisfaction is felt as prominent firms have secured a large amount of work in connection with the electrification of South African Railways for which the Metropolitan-Vickers Co., Manchester, has secured contracts for seventy electric locomotives to the value of £1,000,000. Considerable developments in connection with the electrification of many of the local systems of British Railways are being considered, and the Great Eastern Railway is having an electric locomotive built for passenger service and designed to draw a 450-ton train at 65 miles per hour. It is also capable of attaining a maximum safety speed of ninety miles per hour.

Apart, however, from the few instances noted there is little cause for optimism, and the hopes for a steady increase in business in the new year have proved unfounded. Very little new business is being done. That there exists, however, a big potential demand is shown in the case of a well-known machine tool concern in Yorkshire which, while working short time with a minimum force, finds it necessary to work over-time in the estimating department.

Overseas Trade

During the whole of last year the exports of machine tools showed a fairly steady decline from month to month. As against 2800 tons having a value of £400,000 exported in January 1921, only 760 tons having a value of £112,000 were exported in December. After a rapid fall to a little over 200 tons in March, the imports of machine tools remained somewhere around this figure for the rest of the year. During December the value per ton of imports fell below that of exports, the figures being £125 and £148, respectively. This very unusual condition was, to some extent, due to the increased value of the pound sterling in America. In passing, it is interesting to note that the total exports for the United Kingdom, based on 1913 prices, were in 1920 about one-third less than those of 1913, whereas in 1921 the exports amounted to less than half those of 1913.

Materials and Prices

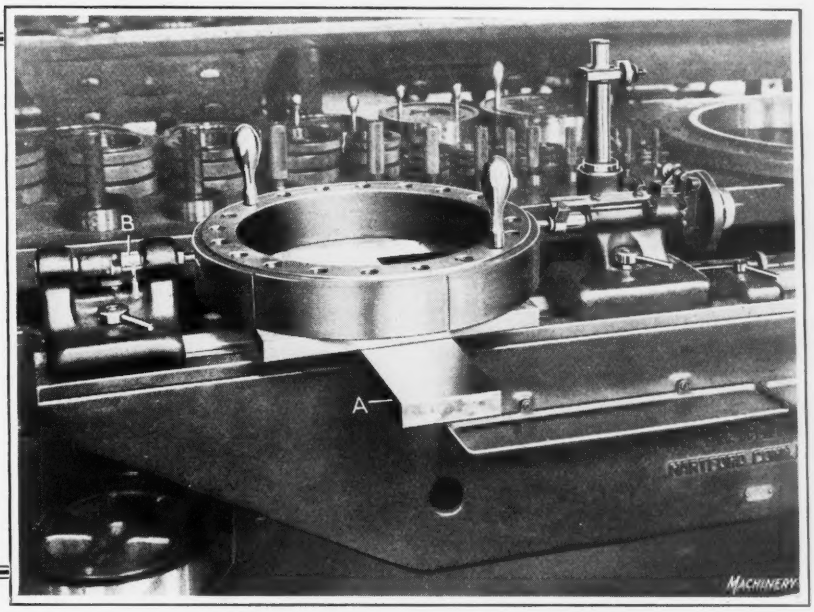
British makers in the iron and steel industry are beginning the year in an extremely favorable position as compared with a year ago, and although at present they are working in many cases below cost in order to provide employment, the outlook is regarded as more promising than for the last two years. Costs are being stabilized and there is some evidence that new orders are to be placed. The industry appears to be passing to a more active condition.

Any increased business seems to be generally at the expense of Continental and American makers. Because of the pig iron, freight and railway charges Continental firms find it almost impossible to compete with British manufacturers in the home market. The price of pig iron has fallen between 5s and 10s per ton during January, and now stands at £4 to £4 10s, according to the grade. Finished steels remain constant at a price between £9 and £11 15s for bars and plates.

As regards the prices of machine tools, there has been a movement in favor of drastic reduction, as a means of stimulating trade, but the majority of makers are convinced that no concession which it would be possible for them to make would have any material effect. Generally speaking, in the Midlands machine tool prices are about 20 per cent below those prevailing at the end of 1920. Although the price of raw materials and wages has dropped in some cases by considerably more than this amount, very few works are running at full capacity, and the heavy overhead in relation to the reduced output has materially increased the cost. The only way out appears to be by the usual route of increased demand, and until that arises prices cannot reach a stable level.

Measuring Thread Plug Gages

By J. M. HENRY
Pratt & Whitney Co., Hartford, Conn.



ACCURATE and convenient measurements of thread plug gages are made in the mechanical laboratories of the Pratt & Whitney Co., Hartford, Conn., through the use of the measuring machine manufactured by this concern. In the heading illustration is shown the usual method of mounting large casing gages for checking their taper threads by the three-wire system of measurement. Block *A* is mounted directly on the vee and flat way of the machine and held in place by means of a bolt and nut engaging the T-slot of the bed. The top surface of block *A* is machined at an angle relative to the bottom surface, this angle corresponding to the taper per foot of the gage thread to be measured. In the case illustrated, the taper is 3/8 inch per foot and the gage is about 15 1/2 inches outside diameter.

Block *A* is placed on the bed in such a manner that when the gage is mounted on parallels to bring it to the required height relative to the measuring anvils, the side toward the dividing head of the machine is at right angles to the anvil face of the dividing head. The opposite side is at an angle with the tailstock anvil corresponding to twice the taper per foot of the gage threads. The reading is obtained over the three wires by using the machine in the regular manner. At the time the photograph was taken the measuring point had been reached, as is indicated by the drop plug *B*, the handle of which has dropped from a horizontal to a vertical position. The exact pitch diameter of the gage is accurately computed from the reading obtained, by allowing for the angle of the side with the tailstock anvil.

Small plug gages are set up in a somewhat similar manner to that described, although the apparatus used is smaller. As shown in Fig. 1, a cast-iron block *A* is usually mounted over the ways. This block resembles those used for supporting end measures, but it is machined flat on the top instead of having a vee extension. Parallels are placed on top of block *A* to bring the portion of the thread to be gaged between the measuring anvils. The ideal condition is reached when the two wires on the tailstock side are equidistant from the center of the anvil, although measurements can be taken so long as both wires bear against any point on the anvil face. Taper blocks are used for small taper gages in the manner previously described for the large casing gage.

A device for measuring thread plug gages when held between centers is illustrated in Fig. 2. A baseplate *A* is secured to the ways of the machine, and on top of this plate is carried a second plate *B*, which has a T-slot at each end for securing the stationary center *C* and the movable center *D* to it. Plate *B* is mounted on three balls to allow freedom of movement when taking a measurement. At the back end of the lower plate *A*, a ball rests in a V-groove, and directly above it, there is a hardened steel button in the top plate,

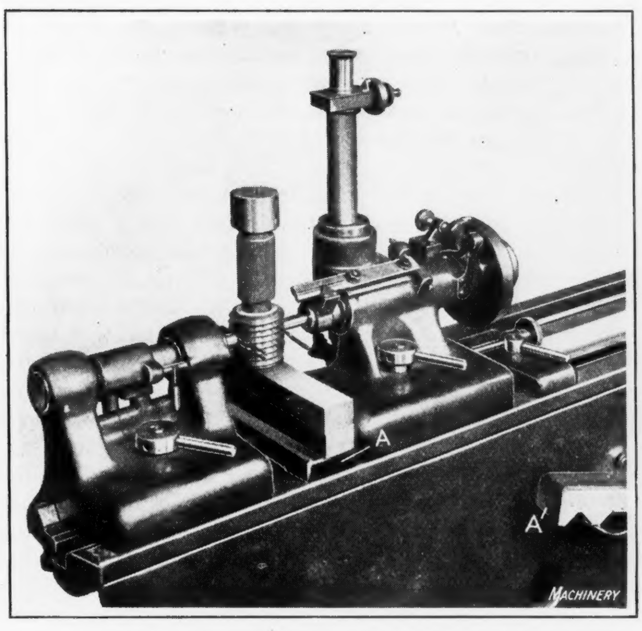


Fig. 1. Method of mounting Small Thread Plug Gage for measuring by the Three-wire System

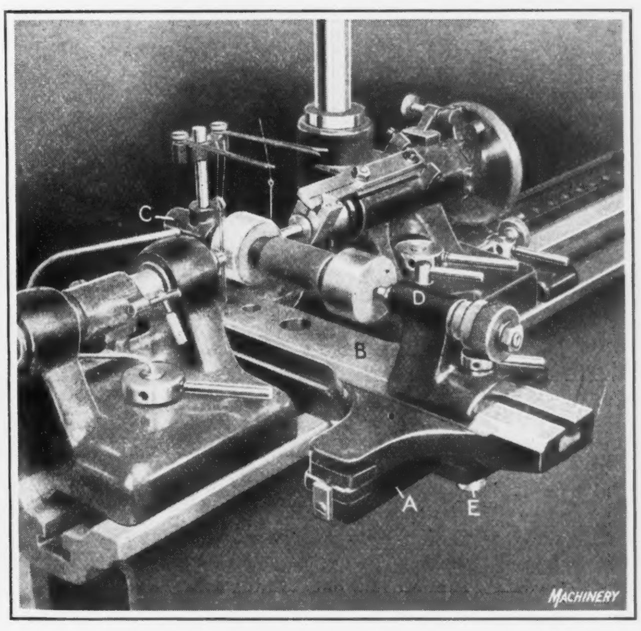


Fig. 2. Attachment developed to facilitate the measuring of Thread Plug Gages held between Centers

which rests on the ball. At the front end of the attachment two balls are used to provide ample support, one being placed at each end of the extensions of the plates. These balls are held between V-grooves in the upper and lower plates, and stops prevent them from falling out.

By this method of mounting, a gagé may be brought between the anvil faces without the difficulties experienced with a solid mounting, because the floating movement of the upper plate, which rolls on an axis parallel to that of the anvils, insures that the measuring pressure of the anvils will not be affected. To prevent the plate from rolling too easily and endangering the anvil setting by causing the drop plug to fall out, a spring friction device fastened to the lower plate bears against the upper one. The friction is applied by operating knob *E*. The stationary center *C* is provided with an adjustable rod carrying a bracket from which fingers extend to permit the suspension of the three measuring wires over the gage. The movable center is adjusted by a knurled screw-knob. Both centers can be clamped and adjusted to suit the length of the plug gages.

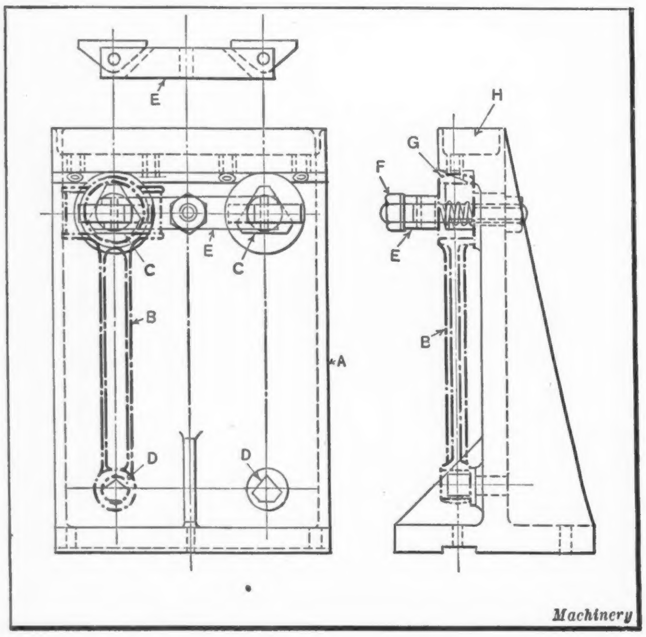
* * *

JIG FOR DRILLING CONNECTING-RODS

By WILLIAM OWEN

The jig illustrated was designed for use on a Moline "Hole Hog," and is so proportioned that two or three jigs can be lined up and bolted to the machine table if desired. The body *A* is of cast iron and is well ribbed. It is slotted on the bottom to provide a means of accurately locating the base on the machine table. One connecting-rod is shown in place by dot-and-dash lines at *B*. The connecting-rod is located at the top by the plug *C* and at the bottom by the plug *D*. These plugs have three bearing surfaces, a feature which eliminates much of the annoyance that would otherwise result from chips clinging to the plugs, and it also allows the rod to be slipped on easily.

The rods are held in place by an equalizing clamp *E*, actuated by the stud and nut *F*. One turn of the nut permits the clamp to be turned to a perpendicular position and the connecting-rods to be taken off or put on. This clamp will not twist the connecting-rod no matter how tight it is.

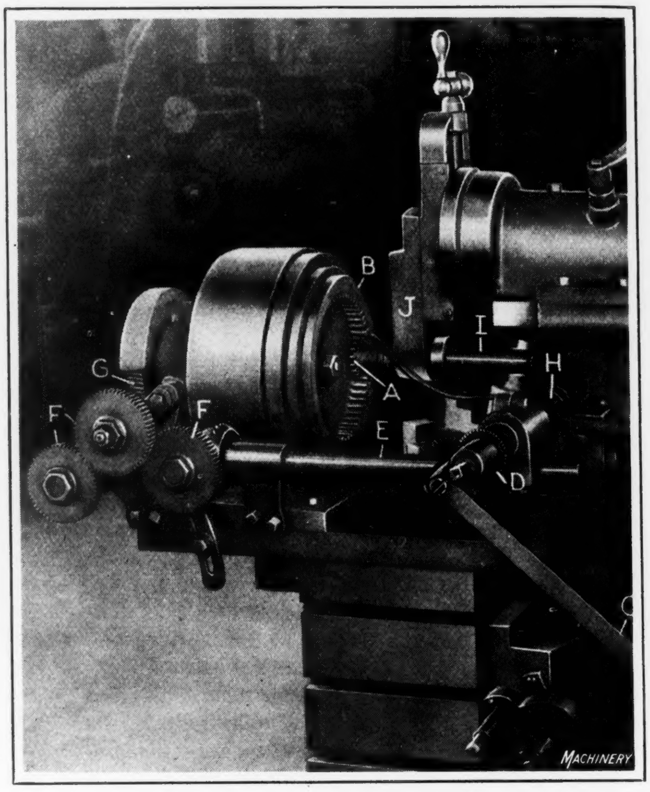


Drill Jig used in drilling Bolt Holes in Connecting-rods

The front edge of the arm in which the bushings are mounted is cut back at *G* so that the chips can work out, thus preventing drill breakage from this source. The cutting compound is fed to the drills by means of the trough *H*. This jig has proved accurate, is self-cleaning, and is adapted to high production rates.

CUTTING TEETH OF INTERNAL GEARS ON A SHAPER

The accompanying illustration shows a 14-inch crank shaper equipped with an auxiliary mechanism for cutting the teeth of an internal gear. Three functions are required of this mechanism, namely, the rotation and reciprocation of a formed gear-tooth shaping tool *A* over the face of the work *B*, and the indexing of the work, it being obvious that



Shaper equipped with a Special Attachment for cutting the Teeth of an Internal Gear

these movements must be synchronous. The way in which the desired movements are produced is described in the following paragraphs:

The link *C* extending up from the feed works actuates a pawl engaging the teeth of ratchet wheel *D*, it being possible to adjust the mechanism so that various numbers of ratchet teeth may be skipped by the pawl at each stroke to obtain the desired operating conditions. From the ratchet wheel, power is transmitted through a pair of spiral gears and a horizontal shaft *E* to a set of change-gears *F*, and by substituting different wheels provision may be made for obtaining the correct timing for cutting the teeth of gears with various numbers of teeth. The work-spindle is driven from gears *F* through the medium of a worm and worm-wheel as shown at *G*.

A horizontal shaft *H* transmits power through a pair of spiral gears to a spindle *I*, at the forward end of which the gear-shaping tool *A* is carried. Spindle *I* is splined into its driving gear and held by a special block *J* on the tool-head of the shaper, so that the spindle is free to rotate in this block but cannot move transversely through it. As a result of this connection of the spindle to both the reciprocating shaper ram and the rotating mechanism deriving power from ratchet wheel *D*, a combined rotary and reciprocating movement is imparted to the gear-shaping tool *A*. The stroke of the shaper is adjusted so that the tool just passes over the face of the gear blank in which the teeth are to be cut, and reverses in a clearance space provided at the back of the teeth for that purpose. On the job shown the gear to be cut has fifty-five teeth of 7 pitch, with a face width of 1 7/32 inches, and the time required for taking the roughing and finishing cuts in a gear of this size made of drop-forged steel is 1½ hours.

Planning in Large Contract Plants

Cards and Records Used in Planning and Dispatching Work

By GEORGE H. SHEPARD, Professor of Industrial Engineering and Management, Purdue University

THE duties of the various units and members of a planning organization in a large contract or jobbing plant were discussed in December MACHINERY. The present article illustrates the different forms used in the functioning of a planning department of a large machine shop and describes their purpose. There are sixteen of these forms as follows: Job and shop order slip; shop memorandum slip; foundry credit memorandum; incoming plant delivery tag stub; outgoing plant delivery tag; material list; shop store stub; stub requisition; inter-shop order; progress card; instruction card; route tag; inspection tags; damage report; sample tag; and drawing index card.

Files in Planning Office

Five files are used in keeping the records of the planning office. In one file are kept the progress cards, which are divided into two sections—active and inactive. The cards filed in the active section are those for orders that have been started in the shop, while the cards placed in the inactive section are for orders not yet given to the shop. On each card is indicated the actual progress of work in the shop for the corresponding order. In another file are kept jackets or containers for various data pertaining to a job, these jackets being filed under the name of the customer in the correct sequence of job order numbers.

A file for instruction cards is placed at the desks of the shop foremen, and this file is divided into pending and available sections. In the pending section are filed instruction cards covering work for which the material has not been delivered to the section or for which something requisite to the performance of the operation is lacking. In the available section are kept the instruction cards of the work for which the material has been delivered and which is ready to be performed. The fourth file consists of a perpetual inventory of shop stores. The latter consists of the bulk of the material frequently called for, and the inventory is kept in the customary manner. The fifth file is an ordinary tickler file for following up the delivery to the machine shop of material from other shops.

Job and Shop Order, Foundry Memorandum, and Delivery Tags

The job or shop order slip is issued by the central planning office and, as its name indicates, contains the job and shop order for work to be performed. The slip is sent from the central planning office to the departmental chief planner for his observation. It is next sent to the method man to be noted by him, and then to a clerk who fills in the data on a progress card as shown in Fig. 8, and on the jacket. The slip, together with the progress card and jacket is next sent to the inter-shop man who studies the shops that will handle the work and records this information in the proper place on the progress card. He then places the progress card in the inactive section of the file previously mentioned, and sends the job order slip and the jacket to the schedule man. The latter notes the job order, where blueprints will be needed, advises the blueprint man to secure the necessary prints of the parts, and then sends the order slip with the jacket to the jacket file. The job order is now represented

DELIVER TO | SHOP, STOREHOUSE | **Foundry Credit Memorandum** | SHOP | № 31902

DATE	OBJECT	JOB ORDER OR ACCOUNT	S. O.

PATTERN NUMBER	DRAWING NUMBER	PC. NO.	MIXTURE	CLASS	PRICE PER LB.	ITEM NO.

NO. PIECES	DESCRIPTION OF CASTINGS	WEIGHT IN LBS.	EXTENDED AMT.
	Received the Above Articles	Total	

Date (Sig.)

Fig. 1. Memorandum Slip on which is placed Information Relative to Castings delivered by the Foundry to the Receiving Clerk of the Machine Shop

DELIVERY

JOB ORDER NUMBER	ITEM	DATE

Drawing No. ______ Pc. No. ______

From ______

No. Pieces or Containers and Description

38051 ______

Fig. 2. Incoming Plant Delivery Tag Stub

by the progress card in the inactive section of the progress card file, which is continually reviewed by the schedule man.

Information and instructions from other shops regarding the job are written on a memorandum slip and never are accepted orally. This memorandum slip is received from outside shops by the receiving clerk and sent to the progress section which indicates the urgent items, from which it is sent to the chief planner for observation, after which it goes to the method man to be noted and assigned to a planner who plans the progress of the job through the shop. It finally goes to the jacket file.

Information relative to castings delivered by the foundry to the machine shop is given on the memorandum slip illustrated in Fig. 1, which is filled out by a clerk in the foundry office and delivered with the castings to the receiving clerk of the machine shop. The latter sends the memorandum to the progress section, where urgent items are suitably marked, after which the slip is sent to the chief planner to be noted by him. The chief planner next sends the memorandum to the method man who assigns it to a planner. The latter makes out the instruction card shown in Fig. 9 and the route tag shown in Fig. 11. The memorandum is then returned to the receiving clerk with a route tag; he places the route tag on the work and returns the memorandum to the progress section. The progress clerk notes on the progress card the receipt of the castings and sends the memorandum to the foundry. The foundry progress clerk notes receipt by the machine shop on his progress card and files the memorandum in his jacket file.

The incoming plant delivery tag stub shown in Fig. 2 is attached to material delivered to the receiving clerk of the machine shop, who tears off all but the narrow strip above the words "Job Order Number" etc., on which he marks for identification, the serial number of the stub, which in this case is 38051. The receiving clerk sends this stub to the progress section to have urgent items marked, and it is then sent to the chief planner to be noted. As in the case of the foundry memorandum, a planner also fills out an instruction card and a route tag and sends the stub with the route tag to the receiving clerk. The latter returns the stub to the progress section for noting on the progress card, it being later sent to the shipping clerk.

To ______

Rec'd. by ______

38051 TO BE PUNCHED BY DRIVER

JOB ORDER NUMBER	ITEM	DATE

Drawing No. ______ Pc. No. ______

To ______

No. Pieces or Containers and Description

38051 TO BE PUNCHED BY DRIVER.

Fig. 3. Outgoing Plant Delivery Tag

The plant delivery tag for outgoing material illustrated in Fig. 3 is torn from the tag in Fig. 2, which originally has three sections, each of which is filled out by the shipping clerk. Of the three sections, the first (Fig. 2) goes with the material to its destination, the second (Fig. 3) goes to the files of the transportation department, and the third (Fig. 3) is stamped with the date and sent to the progress section of the shop that makes the shipment, to be recorded on the progress card. This portion of the tag is then placed in the jacket file.

Material List, Shop Store Stub, Stub Requisition and Inter-shop Order

The material list shown in Fig. 4 is made out in duplicate by the planner for each job, care being taken to give the number of pieces and the size to which stock is to be cut. The route tag number is also given for identification purposes. The planner sends the duplicate copy to the progress section so that it can be recorded on the progress card, after which it is sent to the jacket file. The original copy is sent with the route tag to the material man who fills out the shop store stub, Fig. 5, and the stub requisition, Fig. 6.

The shop store stub is a requisition on stores already issued to and kept in the shop. Each item on the stub must have the route tag number or numbers for the items on the job order for which the material is intended. The material section makes three copies of the shop store stub, one of which is clipped to the material list and sent to the jacket file. The other two copies and the route tag are given to the move man, who gives one of the stubs to the shop storekeeper to keep as a record. The route tag is attached to the work, which is then trucked to the desired section of the shop. The second copy of the shop store stub given to the move man is then signed by the supervisor receiving the material, and sent to the progress section, after which it is placed in the jacket file. The copy of the stub attached to the original material list and this list are then destroyed.

DATE STUBBED MATERIAL LIST JOB ORDER NO. S. O.

DR. OBJECT

PC. NO.	QUANTITY	UNIT	DESCRIPTION OF MATERIAL	ITEM	ROUTE

Machinery

Fig. 4. Material List which gives the Number of Pieces and Sizes to which Stock is to be cut

The stub requisition, Fig. 6, is a demand made directly on the general storekeeper of the plant for material. Each item on this requisition must show the route tag number or numbers for the items on the job order for which the material is intended. As previously stated, the stub requisition is filled out in the material section from the material list and route tag received from the planner, four copies being made. One copy is clipped to the route tag and material list, and retained by the material man as a tickler. The other three copies are sent by mail or by an emergency trucker to the storehouse, from which the material and two copies of the requisition are taken by the transportation department to the shop store-room. Here one copy is signed by the shop storekeeper and sent back to the storehouse, while the other (the third) copy is sent to the material man. The latter copy with the route tag is then given to the move man and the other copy held by the material man is placed in

the jacket file. After the move man delivers the material to the proper section of the shop, the third copy is signed by the supervisor receiving the material and sent to the progress section to be noted on the progress card; it is then sent to the jacket file, after which the copy previously placed in the jacket file is destroyed.

The inter-shop order is illustrated in Fig. 7; this is made out in triplicate by the planner. On orders of this kind for the foundry, the route tag number of the item is included so that the foundry clerk may write this number on the foundry slip for future identification of the items. After an inter-shop order has been filled out, the planner sends one copy to the method man for approval, who forwards it to the chief planner of the central planning office for his information and approval; if he disapproves of it he vetoes it. The other two copies are sent to the progress section to be noted on the progress card, after which one of these copies is sent to the shop where the work is to be done, and the duplicate is placed in the jacket file. The inter-shop order is a means of securing the flexibility and promptness of procedure necessary in a contract or jobbing shop. By using it as directed, the planning office of any shop can order necessary work directly from another shop without the intervention of the central planning office unless the chief planner of the latter sees fit to exercise his veto power.

DEPT. OR STORE	DELIVER TO	BUILDING	STUB REQUISITION	SHOP OR OFFICE	NUMBER
					86150

DATE	OBJECT	JOB ORDER OR ACCOUNT	S. O.

CHECKED BY	SERIAL No.	REQN. No.	CALL No.	PRICED BY

STOCK NUMBER	QUANTITY	UNIT	ITEM AND DESCRIPTION	ITEM NO.	UNIT PRICE	EXTENDED AMOUNT

RECEIVED (DATE) (SIG.)	APPROVED	DELIVER AND CHARGE AS INDICATED (SIG.)	TOTAL	

Fig. 6. Stub Requisition for Material held by the General Storekeeper of the Plant

JOB ORDER NUMBER	SHOP No.	SHOP STORE STUB	STUB No.	DATE

Tag No.	Item and Description	Unit	Quan.	Unit Price	Extension	St.Cd
Received	Deliver					
		Extended by	Total			

THIS COPY TO ACCOMPANY MATERIAL WHEN ISSUED.

Fig. 5. Shop Store Stub used to requisition Stores already issued and kept in the Shop

The Progress Card

The progress card which has been referred to a number of times in the foregoing is illustrated in Fig. 8 partially filled out. On this card the different symbols represent the following machines and departments: B1, milling machines, shapers, and gear-cutters; C, engine lathes up to 36-inch swing; S, machined parts store-room; YC, assembly section; and YCA, disassembly space. The numbers in the column headed "Source and Receipt" represent other shops.

In making out the progress card, a typist fills in the job order number, object, any essential information as a "brief" of the job, the issue date of the order, and the number of the shop receiving the original order. The card is then sent to the inter-shop man, who, if the job order has a completion date, determines the dates on which all items and the order as a whole should be completed in the machine shop. Information or instructions necessary for other shops, and the delivery that other shops must make to the machine shop, are also indicated on the progress card by the inter-shop man.

The progress card is then sent to the planner who fills out each item, giving a description of the item, the number of pieces desired, the kind of material, the pattern number, his signature, and drawing, piece, and route tag numbers. When the material list is issued, the planner puts a diagonal line in the "Material Ordered" column, and when the inter-shop order is issued he puts the date under the diagonal line. When instruction cards are sent to the method man, the planner inserts a date in the "Instruction Cards Issued" column. He also places a date under "Material" in the "Source and Receipt" column, upon the receipt of a foundry slip or incoming plant delivery tag stub, showing that the material has been received in the machine shop.

The progress card is then sent to the progress clerk, who checks entries made by the planner upon receipt of the material list, the inter-shop order, the triplicate instruction cards, the foundry memorandum slip, and the incoming plant delivery tag stub; inserts a date in the "Material Ordered" column, over the diagonal line placed by the planner, upon the receipt of the requisition for the material on its way to the stores; places a diagonal line under the letter in the "Routing" column for the section from which a white inspection tag of the type shown in Fig. 12 is received; inserts the date of receiving an instruction card marked complete, under the letter in the "Routing" column for the section

FROM	TO	INTER-SHOP ORDER	JOB ORDER NO.	S. O.
DR.	OBJECT		DATE ISSUED	

PC. NO.	QUANTITY	DESCRIPTION OF WORK	ITEM	DATE REQUIRED	DATE PROMISED

Machinery

Fig. 7. Inter-shop Order used by Planning Office of a Shop to order Work from Another Shop without Permission from Chief Planner of Central Planning Office

JOB ORDER NO. | S. O. | CARD. | OBJECT | BRIEF

INFORMATION: Back of A-11

SHOPS INVOLVED AND SCHEDULE DATES | DATE ISSUED | DATE COMPLETED

PCS.	ITEM	MAT'L	PATT	SIG.	DR. NO.	PC. NO.	TAG NO	PREPARATION: Blueprints, Sketches or Samples Issued	Instruction Cards Issued	Tools Requisitioned	Interferences Covered	Material: Ordered	Source and Receipt	ROUTING, COMPLETION, INSPECTION	ITEMS SCHED. From	By	REMARKS
4	Sets wrist pin brasses			Cats	Instruction		10,011		12/30				YCA	BI S			
2	" crank " "			"	"		10,012		12/30				YCA	BI S			
	Crosshead Group			"	"		Grp T. 10,013		12/30				S	YC S			
1	Eccentric Strap			Misc	"		10,014		12/30				YCA	BI S			
1	Knuckle			"	"		10,015		12/30				YCA	YC C S			
1	Piston valve			"	Instruction + sample		10,016		12/30			12/30	94	C S			
1	" " yoke			"	Instruction		10,017		12/30				YCA	YC C S			
1	" " stem + 2 nuts			"	Instruction + sample		10,018		12/30			12/30	31	C S			
1	" " stem guide			"	"		10,019		12/30			12/30	94	C S			
1	set metallic packing			"	"		10,020		12/30			12/30	94	C S			
1	Gland			"	~~Instruction~~		10,021		12/20				YCA	C S			
	231																

Fig. 8. Progress Card upon which a Record is kept of the Progress of Work through the Shop

from which the card was received; inserts the date of receiving a plant delivery tag stub showing the shipment of material, under the number of the shop to which the material should be sent as shown by the routing schedule; and inserts the date of receiving the signed requisition triplicate under "Material" in the "Source and Receipt" column.

Instruction Card and Route and Inspection Tags

The instruction card, Fig. 9, forms a basis for the progress records and should be filled out accurately. In the "Item" space is given a description of the job and the kind of material to be used. In the "Description" column, instructions are given to the shop concerning the method in which the job is to be performed. Such a clear and detailed description of work to be done should be given that the man who is to do the work will readily understand what is wanted. Free-hand sketches are of practical value in this respect. The instruction card is furnished in four colors—white, yellow, blue, and pink. The white card is for customers' orders and tool orders; the yellow card for special manufacturing orders; the blue card for stock orders; and the pink card for rush jobs.

The planner makes three copies of the instruction card, one copy being sent to the progress section so that the necessary entries may be made on the progress card, and then to the jacket file. The other two copies are sent to the method man for approval and then to the foreman of the shop concerned. Upon the completion of the work, the foreman retains one copy for his private file and forwards the other to the progress section to be noted on the progress file, after which it is placed in the jacket file. The instruction cards filed in the jackets are the basic records from which can be summarized, as desired, the quantities of various parts made and of the materials used. All carrying of stock and determining of maximum and minimum limits should be based on these records. They also are valuable in deciding whether it will pay to specialize or standardize the making of any product, that is, to change its production from a jobbing to a manufacturing basis.

The route tag issued by a planner for a job is shown in Fig. 11. On the back of this tag is a list of the shops and departments through which the work must pass, the shops and departments being numbered serially to indicate the intended route. Group and master tags are made out in red ink, while tags for individual items are made out in black. The planning office uses a white tag for partial deliveries of work, while shop supervisors use a green one, thus denoting the partial lots originating in the shop. If a planner

INSTRUCTION CARD

Date Issued	Object	J. O.
Progress Sheet	Stowage	Operator
Sec.	Planner	Move to
Item		Drg.

Drawing	Pc. Mark	No. pcs.	Tag No.	Description

Fig. 9. Instruction Card giving Information to the Shop as to the Manner in which a Job is to be performed

DAMAGE REPORT

CHECK NUMBER | DATE

Name .... Trade .... Rate ....

Item ....

J. O. .... Plan .... Piece ....

Material .... Pattern .... Tag ....

Replaced on J. O. ....

Remarks: ....

Fig. 10. Report made out by the Foreman of a Department in which Work has been damaged

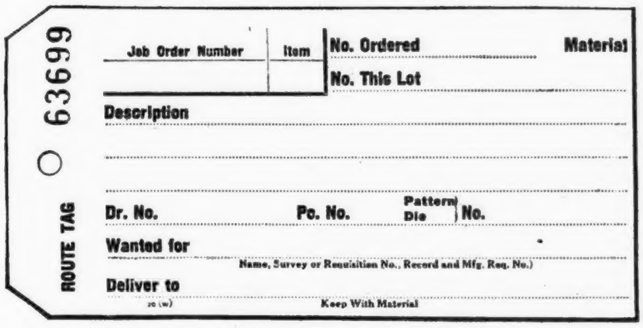

63699
ROUTE TAG
Job Order Number | Item | No. Ordered | Material
No. This Lot
Description
Dr. No. Pc. No. Pattern Die No.
Wanted for
Name, Survey or Requisition No., Record and Mfg. Req. No.)
Deliver to
Keep With Material

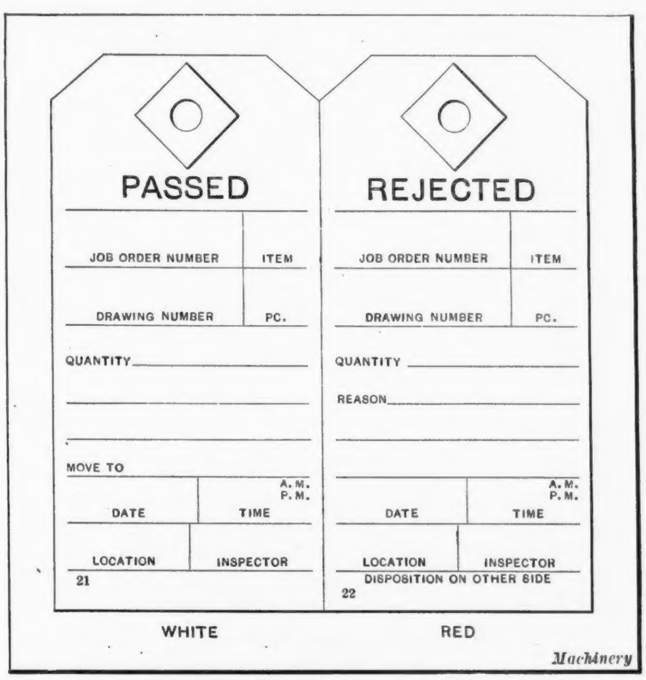
Fig. 11. Route Tag, which gives a List of the Successive Shops and Departments through which the Work must pass

attaches the route tag to a material list, both are sent to the material man, and if the tag is attached to a foundry slip, it is sent with the latter memorandum to the receiving clerk. When material on hand is to be used, the route tag is attached to the original instruction card and follows the same route as this card. The route card remains with the work until the latter is completed, and is then destroyed by the shipping clerk.

The inspection tags used on a job are shown in Fig. 12, the "Passed" tag being white in color, and the "Rejected" tag, red. Both of these tags are made out by the inspector. The "passed" tag is attached to the work and goes with it to the next section, where it is signed by the assistant foreman of the section. It is then sent to the progress section to be noted on the progress card, and finally placed in the jacket file. The "Rejected" tag is sent to the shipping clerk with defective material, and then to the progress section to have the proper notations made on the progress card, after which it is also placed in the jacket file. When an article is repaired, or errors are otherwise corrected, the shipping clerk destroys the red tag.

Damage Report and Sample Tag

When work is damaged in a shop, a report is made out by the foreman of the department on the form shown in Fig. 10. This report is then sent with the defective material to the shipping clerk, who forwards it to the progress section to be noted, on the progress card. It is then sent to the departmental chief planner for his observation, after which it goes to the material man. The latter makes out a credit and debit transfer stub in five copies—two pink, two green, and one white. The damage report and transfer stub are then sent to the departmental chief planner for his approval and signature, after which the damage report is sent to the general foreman for action. The transfer stub is sent to the progress section to be noted on the progress card, after which the white copy is placed in the jacket file. One pink and one green copy of the transfer stub are sent to the shipping clerk, and the other pink and green copies are sent with the material to its destination.


PASSED
JOB ORDER NUMBER | ITEM
DRAWING NUMBER | PC.
QUANTITY
MOVE TO
A. M. P. M.
DATE | TIME
LOCATION | INSPECTOR
21
WHITE

REJECTED
JOB ORDER NUMBER | ITEM
DRAWING NUMBER | PC.
QUANTITY
REASON
A. M. P. M.
DATE | TIME
LOCATION | INSPECTOR
DISPOSITION ON OTHER SIDE
22
RED

Machinery

Fig. 12. White and Red Inspection Tags used for passing or rejecting Work

The sample tag shown in Fig. 13 is attached to a sample which is to be sent to another shop. This tag is filled out by a planner who tears off the stub and sends it to the progress section to be noted on the progress card. The planner attaches the body of the tag to the sample and sends both to the receiving clerk, who forwards them to the shop designated by the tag. This shop later returns the sample and tag to the receiving clerk, who sends them to the section of the shop that is designated by the route tag. At the time the sample is returned with material to the shipping clerk, the sample tag is destroyed. When a request is made to a customer for a sample, the same tag is used, the stub being detached and sent to the jacket file. The body of the tag is sent with the request to the customer, the latter being asked to attach the tag to the sample when forwarding it.

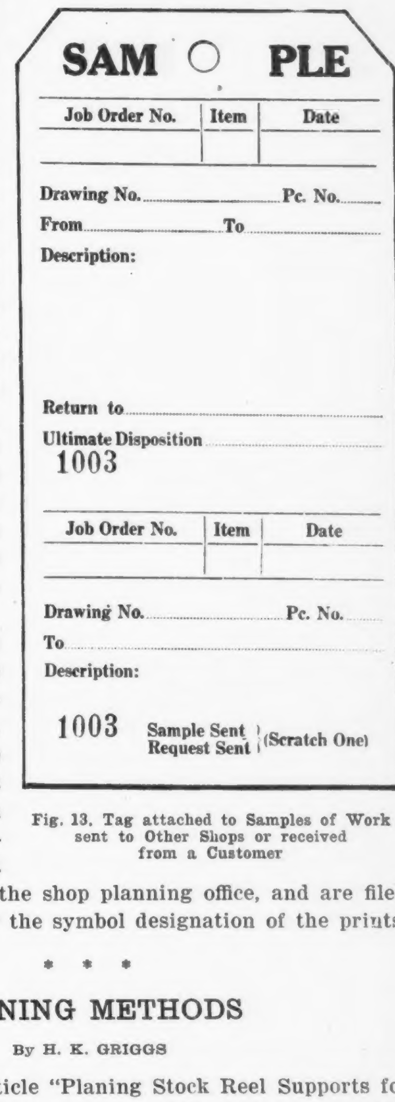

SAMPLE
Job Order No. | Item | Date
Drawing No. Pc. No.
From To
Description:
Return to
Ultimate Disposition
1003
Job Order No. | Item | Date
Drawing No. Pc. No.
To
Description:
1003 Sample Sent / Request Sent (Scratch One)

Fig. 13. Tag attached to Samples of Work sent to Other Shops or received from a Customer

The drawing index card is a record of the blueprints in the possession of the shop. These cards show the supply of every print on hand and to whom prints have been issued. They are kept by a clerk located in the shop planning office, and are filed in card index form by the symbol designation of the prints.

* * *

PLANING METHODS

By H. K. GRIGGS

Referring to the article "Planing Stock Reel Supports for Automatic Screw Machines" on page 205 of November, 1921, MACHINERY, the writer wishes to call attention to a mistake that is commonly made in setting up planer work, namely that of placing the angle-plate wrong side out. This mistake is particularly noticeable in planing such work as the flange faces of large pipe elbows. When the angle-plate is used as shown in the illustrations of the article referred to, there is a tendency for the pressure of the cut to lift the angle-plate from the planer bed, thus causing the tool to dig into the work. The lifting force is sometimes great enough to raise the table sufficiently to bring the pinion out of mesh with the rack and thus cause serious damage to the machine. By turning the angle-plate around, the pressure of the cut will spring the work downward and thus eliminate danger of the tool digging in. In the case of the work referred to, it is the writer's opinion that the castings could be more easily put on the planer if the angle-plate were turned around, and heavier cuts could be taken without causing chatter.

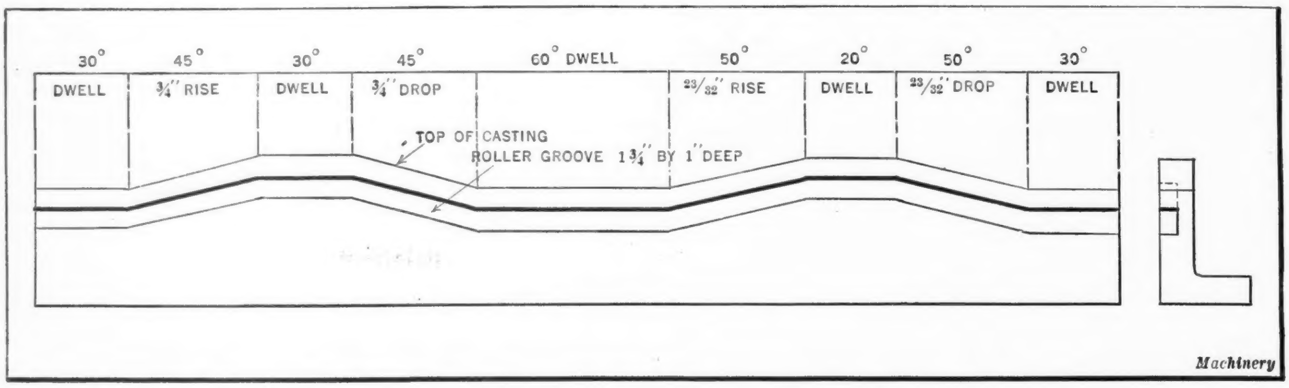


Fig. 1. Lay-out for Large Cam, which was cut on a 48-inch Boring Mill

SPRING MEETING OF THE A. S. M. E.

The tentative program of the spring meeting of the American Society of Mechanical Engineers, to be held in Atlanta, Ga., May 8 to 11, includes a strong technical program, covering machine shop and textile sessions, and papers relating to management, power, fuels, and the handling of materials. The power division's program will relate specifically to hydro-electro power developments in the Southeast. A paper giving the results of recent tests on a 60,000 kilowatt turbine at the Interborough Rapid Transit Co. of New York will also be presented. "Material Handling Equipment in the Steel Industry" will be the subject of one of the papers read; this paper will treat of the entire industry in a comprehensive manner, and will show how the handling of materials hinges on the adequate design of mechanical handling equipment. In connection with the meeting an excursion will be made to Birmingham, Ala., to inspect plants engaged in the manufacture of iron and steel. The programs of the management, textile, and machine shop divisions will all be devoted to problems arising in the textile industry, the machine shop division dealing particularly with textile machinery maintenance. After the sessions in Atlanta, those interested in seeing textile plants in operation will visit Greenville, S. C.

Fig. 2. Plan View of Finished Cam

CAM CUTTING ON A BORING MILL

By ARTHUR MUMPER

Having a cam to cut which was too large to be handled on any of the machines ordinarily used for cam cutting, the writer suggested doing the work on a Cincinnati 48-inch vertical boring mill as described in the following. The cam, which is shown in Fig. 4, was to be used in the construction of a special machine, and was required to be cut accurately. The lay-out for the job is shown diagrammatically in Fig. 1 and a plan view of the finished cam may be seen in Fig. 2.

The first thing to do was to get the ram of the machine to slide up and down with the least possible friction. An attempt was made to remove the pinion from the short feed-shaft which runs from the front to the rear of the ram on the boring mill. This proved impossible without removing the saddle from the cross-rail, and as time was an important consideration in this case, it was decided simply to remove the rack from the ram and fasten a bar of cold-rolled steel in its place, making this bar just enough smaller to allow the front pinion to clear it. This served the purpose, but it was found necessary to fasten a heavy counterweight on the ram, in order to make the tool follow the drop of the master cam, and reproduce the correct shape on the work.

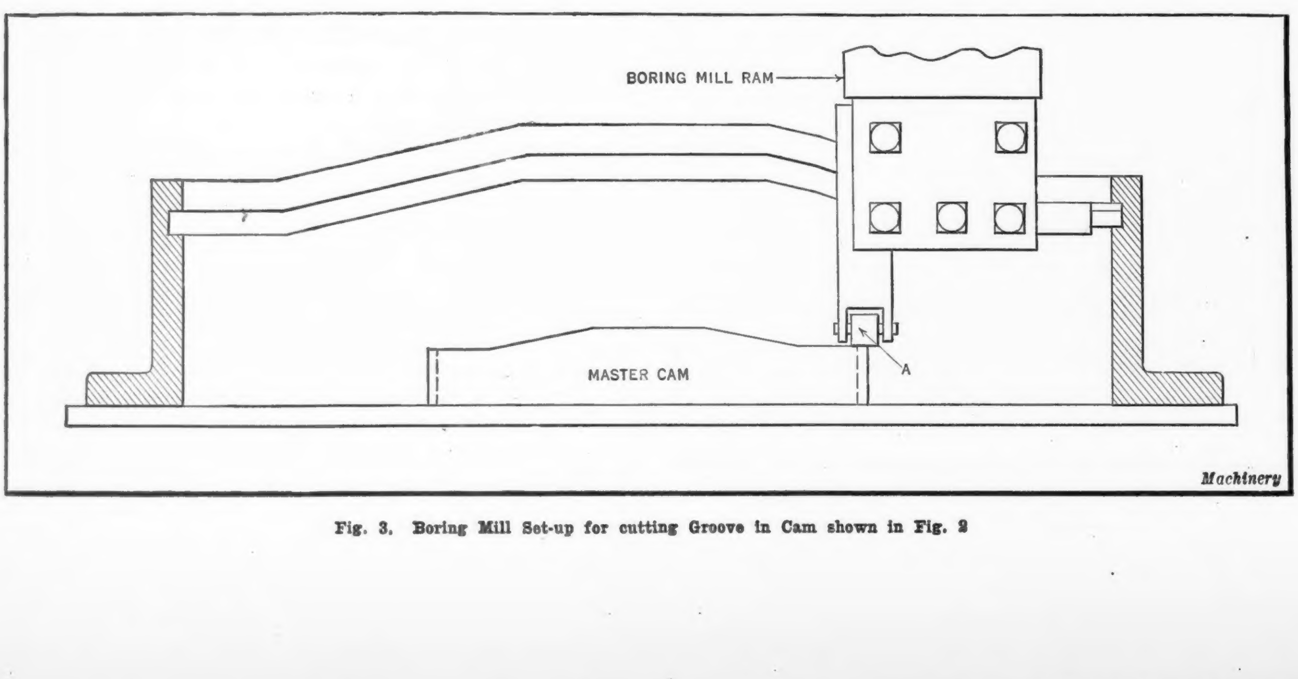


Fig. 3. Boring Mill Set-up for cutting Groove in Cam shown in Fig. 2

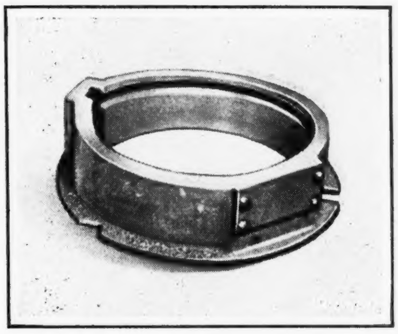


Fig. 4. Finished Cam

From the illustrations it will be apparent that the casting was so designed that it could be easily bolted to a bedplate. Hence a bedplate was cast for this purpose which was held in the chuck of the machine. The master cam was laid out on a bar of cold-rolled steel, ½ by 1¾ inches in size, which was then bent around a shaft 12 inches in diameter, the ends being clamped together. The master cam was 12 inches in diameter, while the diameter of the inside of the cam to be cut was 23⅛ inches. The master cam was clamped on the bedplate and in the true center of the job. Next a roller *A*, Fig. 3, was made and clamped to the inner side of the box-tool holder of the machine. This roller carried the weight of the ram, and as it rode on the master cam it imparted vertical movements to the box-tool holder, which resulted in cutting the cam groove to the required contour. The tool used in cutting the groove was a common straight parting tool about ⅝ inch wide on the cutting edge. As specified in the layout, Fig. 1, the cam groove was cut 1 inch deep by 1¾ inches wide. In Fig. 5 the cam is shown clamped to the boring machine table in position to be bored, previous to cutting the cam groove.

* * *

SCREW THREAD PRACTICE IN EUROPE

The U. S. standard screw thread appears to be little used in Europe. The form in most general use is the Whitworth thread, and consequently the metric countries, particularly Austria, Germany, Holland, Sweden, and Switzerland, are anxious to agree on tolerances for this form of thread. They believe that the Anglo-Saxon countries should take the lead in this work, but are anxious to have an agreement reached as soon as possible. It is reported that Austria, France, Germany, Holland, Italy, Sweden, and Switzerland either have adopted or will adopt three systems of screw threads, namely, the International System (metric), the Metric Fine Thread, and the Whitworth Thread.

The Germans have decided to discard several less used metric systems so as to have not over three in use. They are much interested in the number of threads per inch for the very large Whitworth screws. The German shipbuilding industry wants to continue the use of pitches coarser than four threads per inch on account of their use on British ships, but the other German industries want to limit the number of threads per inch to four, as recommended by the National Screw Thread Commission of the United States.

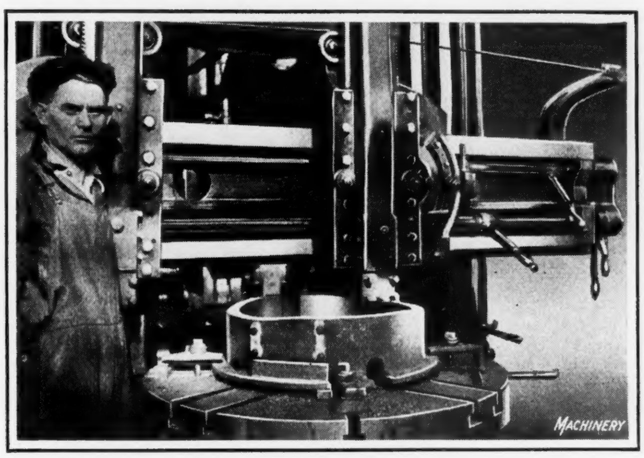


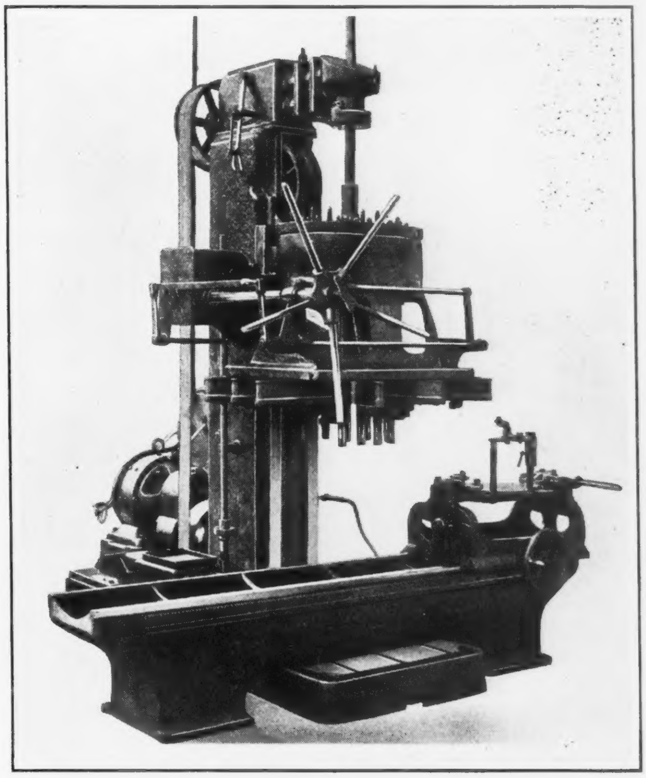
Fig. 5. Boring Operation on Cam

Germany, Holland, Sweden, and Switzerland take the nut as the fundamental basis, according to Secretary Agnew of the American Engineering Standards Committee. The Swiss have done extensive work in establishing screw thread tolerances for metric and Whitworth threads, but the results have not been published. The Dutch standards for bolts are now being revised. The British have organized an association of Bright Nut and Bolt Manufacturers, and this has greatly stimulated work on the general question of screw threads and on the details of nuts and bolts. It is believed that the Society of Automotive Engineers' thread is being extensively used in England, and the British association is undertaking to determine the extent of its use.

* * *

UNIQUE SLIDE FOR TRUNNION JIG

The accompanying illustration shows a unique means of traversing a trunnion jig beneath the spindle head of a No. 14 "Natco" multiple-spindle drilling machine. The photograph was taken in a machine shop in France. It will be seen that the bed of a dismantled lathe has been placed on the floor with the gap between the legs extending over the base of the drilling machine, the ways of the lathe bed being utilized as sliding surfaces for the jig. The latter is fed across the bed by revolving a handwheel on the jig, which rotates a pinion engaging the teeth of the rack on the front of the bed. The bed belongs to a worn-out lathe, and if an enterprising mechanic had not thought of its present application it would no doubt have been scrapped.



Old Lathe Bed utilized as a Slide for traversing a Jig under a "Natco" Multiple-spindle Drilling Machine

* * *

The waste from accidents is one that should be given greater attention than any other industrial waste. In a paper presented before the Industrial Waste Session at the Pennsylvania Industrial Relations Conference, it was pointed out that the rate of accidental death in the United States for each million of population is 860, as compared with 452 in England and 477 in France. Statistics were also presented giving the direct and indirect cost of fatal and non-fatal accidents as $1,500,000,000 annually. This is only the dollars and cents waste. Other elements of loss are not reducible to such a basis and are not replaceable.

Graphic Representation of Absorption of Impact by Springs

By LESLIE H. MANN, Engineer with Perin & Marshall, Consulting Engineers, New York City

THE determination of the energy absorbed by a spring under load as treated herein is based upon the assumption that the body producing the deflection of the spring is moving with its center of gravity in line with the axis of the spring, or in line with the point that will cause the spring to act most efficiently. It is further assumed that the deflection of the spring is proportional to the applied load, and the inertia of the spring is considered to be a negligible factor.

In the formulas,

W = weight of moving body;
V = velocity of moving body in feet per second at instant of striking the spring;
g = acceleration due to gravity (32.16 feet per second);

The general formula for the energy absorbed by a spring during deflection may be written:

$$E = \frac{WV^2}{2g} \pm WF \cos Z \qquad (3)$$

The last term in this formula takes the *positive* sign when the motion toward the spring is *downward*, and the *negative* sign when the motion toward the spring is *upward*. When the motion is *horizontal*, angle Z will, of course, be 90 degrees, and since the cosine of 90 degrees is zero, the last term will in this case disappear entirely and the formula becomes

$$E = \frac{WV^2}{2g} \qquad (4)$$

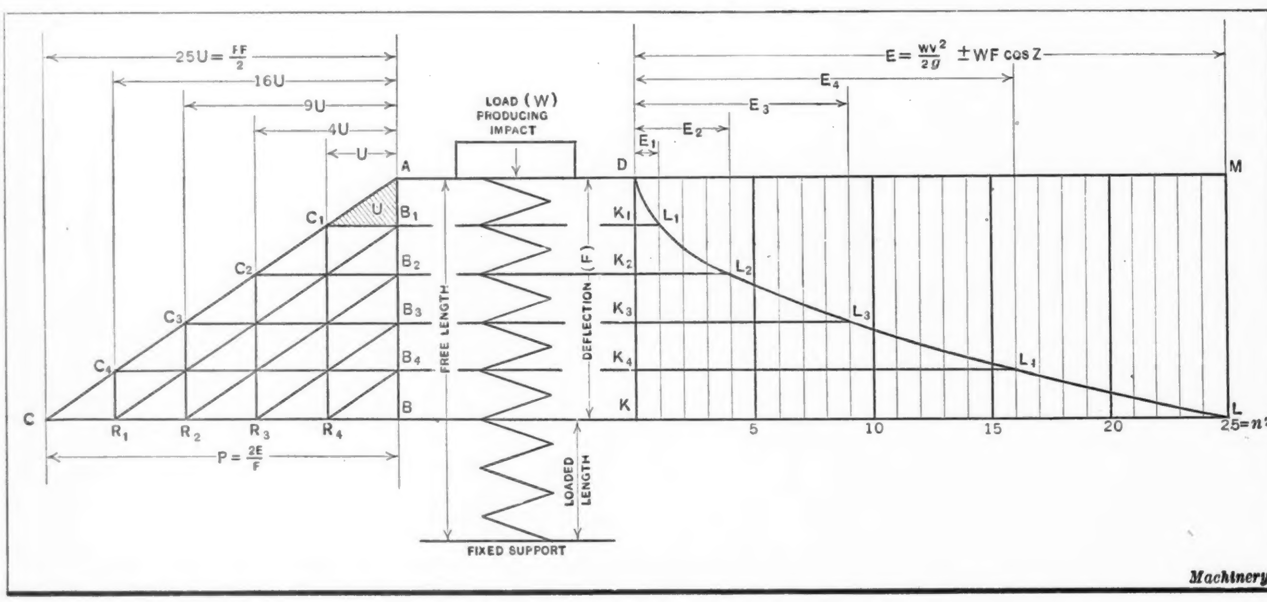


Fig. 1. Diagram for analyzing the Formulas for Absorption of Energy by Springs under Deflection

P = maximum applied force in pounds, or slowly applied load which would deflect the spring as much as will the moving body;
F = deflection of spring in feet;
E = energy in foot-pounds absorbed by the spring during deflection.

From the hypothesis and the laws of mechanics,

$$\frac{PF}{2} = E, \quad \text{or} \quad P = \frac{2E}{F}$$

$\frac{WV^2}{2g}$ = energy of body at instant of striking spring

If the load deflects the spring vertically downward, additional energy WF is developed so that

$$E = \frac{WV^2}{2g} + WF \qquad (1)$$

If the load is directed toward the spring obliquely downward at an angle Z with the vertical, additional energy, $WF \cos Z$, is developed, or

$$E = \frac{WV^2}{2g} + WF \cos Z \qquad (2)$$

The formulas given in the preceding are placed in tabular form for convenience as follows:

Direction of Motion	Formula
Vertically downward	$E = \frac{WV^2}{2g} + WF$
Obliquely downward	$E = \frac{WV^2}{2g} + WF \cos Z$
Horizontal	$E = \frac{WV^2}{2g}$
Obliquely upward	$E = \frac{WV^2}{2g} - WF \cos Z$
Vertically upward	$E = \frac{WV^2}{2g} - WF$

The diagram Fig. 1 represents a load W striking against a helical spring which has a fixed support. The graphic depicting of the formulas is applicable to springs made from wire of any sectional shape, and, in general, to springs of any type. Draw two parallel lines AM and CL, the perpendicular distance between them representing the deflection F.

Draw AB and DK perpendicular to the horizontal lines and parallel to the line of deflection F, and divide these two lines into any desired number of equal parts n, as, for example, five. These divisions are represented by spaces AB_1, B_1B_2, DK_1, etc. Through corresponding division points on AB and DK draw the horizontal lines C_1K_1, C_2K_2, etc. By selecting the proper formula from the above tabulation, which will agree with the condition under which the spring is located, the computation for E may be made, and this value may then be graphically represented by making DM equal to E, using any convenient scale.

After calculating the value of P from the formula $P = \dfrac{2E}{F}$, lay off BC equal to this value, using any other convenient scale. Divide BC into the same number of equal parts as AB was divided into (in this case five), and designate the division points as shown. Complete the triangle by connecting points A and C and then draw similar inclined lines through the remaining division points; also draw the vertical lines C_4R_1, C_3R_2, etc.

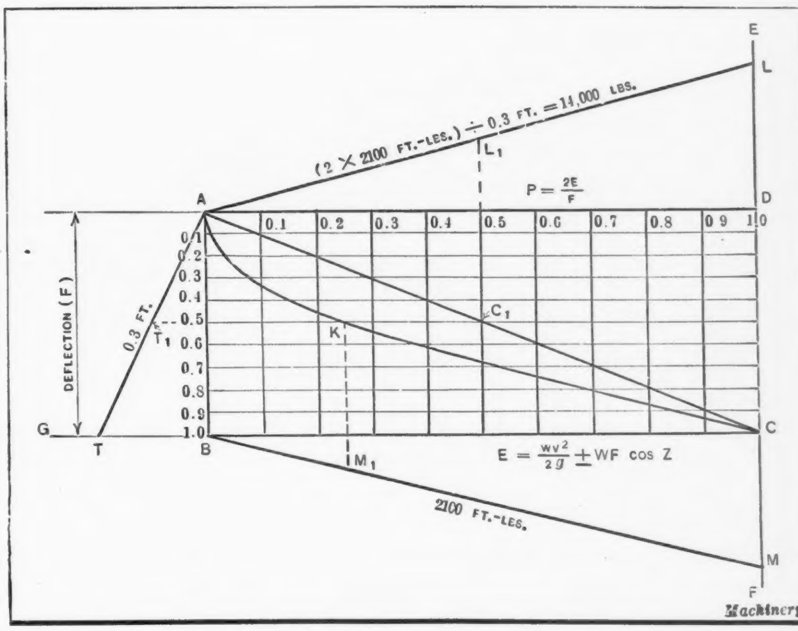


Fig. 2. Graphic Method of determining Values of Spring Deflection, Energy Absorption, and Load

The formula for energy absorbed by the spring has been shown to be $E = \dfrac{PF}{2}$, and since the sides AB and BC of the triangle equal, respectively, F and P, it follows that the area of triangle ABC which is $\dfrac{PF}{2}$, represents graphically the amount of energy E absorbed by the spring in its deflection from A to B. Likewise, the area of the small triangle AB_1C_1 represents the amount of energy absorbed by the spring during its deflection from A to B_1; also the area of the triangle AB_2C_2 represents the amount of energy absorbed through the deflection from A to B_2; and further, the area of each triangle shows graphically the energy absorbed in deflecting the spring a distance equal to the altitude of that triangle. It is evident that the area of the large triangle ABC is equivalent to twenty-five small triangles AB_1C_1, this unit area being designated on the diagram by letter U. Next, divide DM into the same number of parts as there are small triangles in the large one, that is, twenty-five, and from the division points on DK draw K_1L_1, K_2L_2, etc., equal to the same number of these subdivisions as there are units U in the corresponding triangles AB_1C_1, AB_2C_2, etc. A curve, which is parabolic, is then drawn through the termination of these horizontal lines, as shown in the diagram.

ABSORPTION OF IMPACT BY SPRINGS

Deflection	Area Representing Impact	Number of Units U or Parts of DM	Energy Absorbed
D to K_1	AB_1C_1	$1 = 1^2$	$K_1L_1 = E_1 = \dfrac{E}{25}$
D to K_2	AB_2C_2	$4 = 2^2$	$K_2L_2 = E_2 = \dfrac{4E}{25}$
D to K_3	AB_3C_3	$9 = 3^2$	$K_3L_3 = E_3 = \dfrac{9E}{25}$
D to K_4	AB_4C_4	$16 = 4^2$	$K_4L_4 = E_4 = \dfrac{16E}{25}$
D to K	ABC	$25 = 5^2 = n^2$	$KL = E = \dfrac{25E}{25}$
K_1 to K_2	$B_1B_2C_2C_1$	$3 = 4 - 1$	$E_2 - E_1 = \dfrac{3E}{25}$
K_2 to K_3	$B_2B_3C_3C_2$	$5 = 9 - 4$	$E_3 - E_2 = \dfrac{5E}{25}$
K_3 to K_4	$B_3B_4C_4C_3$	$7 = 16 - 9$	$E_4 - E_3 = \dfrac{7E}{25}$
K_4 to K	B_4BCC_4	$9 = 25 - 16$	$E - E_4 = \dfrac{9E}{25}$

Machinery

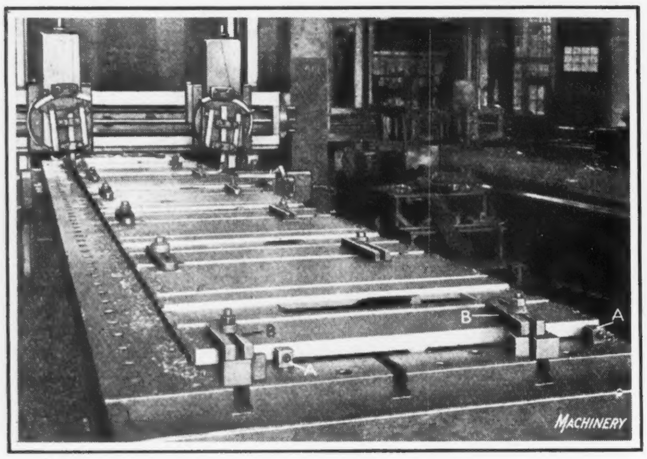
In the accompanying table, the data contained is deduced from the diagram, and shows the amount of energy absorbed during deflection of the spring from its free length to any point of equal division of F, and also the amount of energy absorbed during each successive portion of the deflection. It will be noted that the energy absorbed during the last part K_4K of the deflection is nine times that absorbed through the first part DK_1 of the deflection.

A diagram which may be used to determine graphically the energy and the load values for a given deflection is shown in Fig. 2. The rectangle $ABCD$ has its parallel sides divided into ten spaces each. Draw the diagonal AC and the parabola AKC. Prolong CD through E and F and prolong CB to G. From B lay off the oblique line BM, terminating in the line EF, which will show to any convenient scale the total energy absorbed. In a similar manner, from A lay off AL terminating in line EF, and line AT terminating in line CG, to represent the maximum load in pounds and the deflection in feet, respectively.

From any point of deflection, as T_1, draw T_1C_1 parallel to GC, intersecting the parabola at K and the diagonal at C_1. Drop a perpendicular KM_1 to BM. Where this perpendicular intersects BC, the fraction of the total energy is indicated. Erect a perpendicular from point C_1 intersecting AL; where this perpendicular intersects AD the fractional part of the maximum force or load is indicated. By properly graduating lines AT, BM, and AL, representing assigned total values, corresponding intermediate values of deflection, energy, and load may be quickly determined. It is evident that at 0.5 of the total deflection, the energy already absorbed is only 0.25 of the total energy E; also the corresponding force or load P on the spring is 0.5 of the maximum load. In the present case, where the deflection is 0.15 foot, the energy absorbed is 0.25 of the total energy or 525 foot-pounds; and the load on the spring is 0.5 of 14,000 pounds, or 7000 pounds.

PLANING SAW BENCH TABLES

The accompanying illustration shows a Niles-Bement-Pond planer equipped for planing the ends of saw bench tables in the plant of the Pratt & Whitney Co., Hartford, Conn. Six castings are set up in a string, so that they can be operated upon at one continuous cut. The work is rather unusual because of its great length and width, as compared with the thickness. Two end-stops *A* receive the thrust of the cutting tools and also locate the finished edges of the work at right angles to the line of travel of the planer table. The work is held down by two straps *B* located between each pair of castings. The two cutting tools are of simple design, one operating on each end of the castings. The material is cast iron, and the depth of cut on this job is 1/2 inch, the feed 1/8 inch per table stroke, and the cutting speed 30 feet per minute. The top surface of these castings was planed at a previous setting on the same machine, and this job is of interest because of the large area that is finished. On this operation the depth of cut was 1/16 inch, and the tools were fed at a rate of 7/8 inch per table stroke, with a cutting speed of 30 feet per minute.



Planing the Ends of Wood-cutting Saw Bench Tables

* * *

SNAP GAGE DESIGN

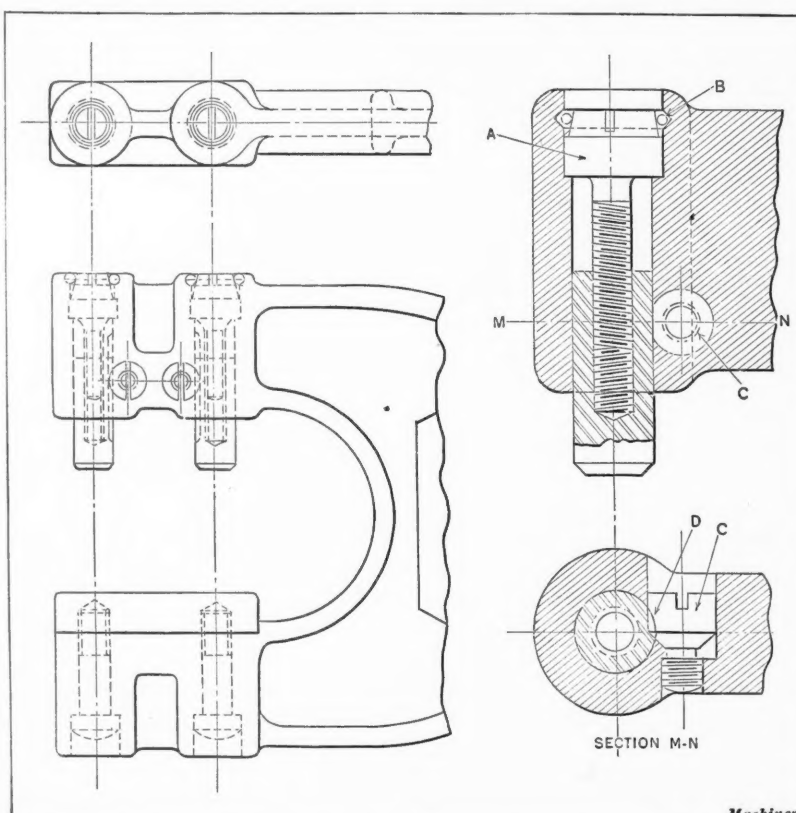
By J. B. CONWAY

A table prepared by the writer, which appeared in August, 1920, MACHINERY on page 1123, gave dimensions for snap gage frames in sizes ranging from 1/4 to 17 inches. The adjusting and locking devices shown in the accompanying illustration were designed by the writer, and have been used successfully on frames of the type described in the article referred to, as well as on gage frames of similar design. In designing snap gages, there are several points that must be carefully considered if satisfactory results are to be obtained. A frame of substantial design, preferably of material that will break before distorting, is of first importance. An adjustable feature to provide for readily adjusting to different sizes, and to compensate for wear, and a locking device or mechanism which provides for independent adjustment of the different parts are practically indispensable.

The design of frames described in the article mentioned will be found rugged and durable. Selection of the material from which they are to be made, either cast iron or other material, is left to the judgment of the designer. Whether four anvils or blocks are employed is also a matter of opinion, and depends somewhat on the conditions under which they are to be used. Referring to the accompanying illustration, it will be seen that means of adjusting the gage plugs and of securing them in position after they are set to the desired points are incorporated in the design. Aside from the frame and anvil this design consists of an adjustable plug, an adjusting screw, a retaining ring, and a locking screw.

The plug is adjusted in or out by means of the adjusting screw *A*, which has a left-hand thread. When the adjusting screw is turned in a clockwise direction, the distance between the gaging points is decreased. To increase the size of the gage the screw is given a reverse movement. The adjusting screw is retained in position by ring *B* which fits in a V-shaped annular groove as shown. This ring is made of spring brass or steel, and is split to allow for closing it a sufficient amount when placing it in position. A groove cut in the plug at *D* is made to conform to the shape of the head of the locking screw *C*. The action of screw *C* when it is forced against the plug is to grip the side in contact with the head, and as further pressure is exerted it binds on the parallel side of the head. This affords a positive lock, and insures setting the plug in its original position with respect to its face whenever it is changed for adjustment or after relapping.

Besides the usual care required in maintaining accuracy in gages of this kind, attention must also be given to the accuracy of the seat on the head of the locking screw and to the angle of the groove in the plug. The proximity of the locking screw to the plug can be such that the distance will just permit the passage of the body of the screw without actual contact between the screw and the plug. This design of locking device can be employed on gages of other types such as large "sweep" or "windmill" gages, inside gages, and various types requiring adjustability of the gaging points or surfaces.

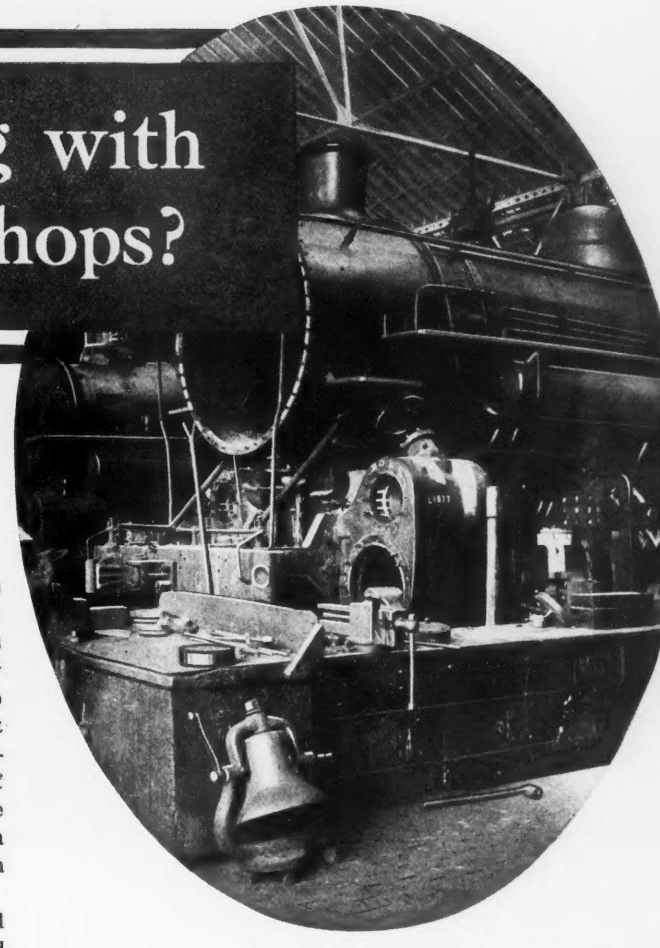


Snap Gage equipped with Adjusting and Locking Devices

* * *

National standardization bodies now exist in fourteen countries as follows: Austria, Belgium, Canada, Czecho-Slovakia, France, Germany, Great Britain, Holland, Italy, Japan, Norway, Sweden, Switzerland, and the United States.

What is Wrong with the Railroad Shops?



An Investigation into the Relative Costs of Performing Machining Operations in Seven Representative Railroad Shops

By EDWARD K. HAMMOND

THOSE who are capable of passing reliable judgment are of the opinion that the average efficiency in American railroad shops is far beneath that of industrial plants engaged on similar lines of work. The trouble is largely due to unsuitable equipment and inefficiency of railroad shop labor. The methods employed are usually satisfactory, but there is room for improvement both as regards the mechanical equipment of the railroad shops and the efficiency of the men employed in them. The railroad's finances have often made shop superintendents hesitate to requisition mechanical equipment which their better judgment told them was imperative.

Labor has been the other drawback. Prior to the period of government control, many of the shops were operated under some piece-work or bonus system that created an incentive to do efficient work, but after the government took control, the so-called National Agreement on Working Conditions abolished all such systems of remuneration and put all the workers on an hourly or monthly pay basis. A falling off in efficiency was inevitable, and this was most pronounced in those shops where bonus or piece-work methods were formerly in use. These piece-work or bonus systems were not only a means of enabling the railroads to get out their work at what was more nearly a minimum production cost, but they also afforded all shop employes an opportunity for greater earnings.

Recently, the United States Railroad Labor Board handed down a decision providing for the re-establishing of various piece-work or bonus systems, and permitting the railroads to deal individually with their shop men; it is expected that if the necessary readjustments can be made in line with these rulings, a higher standard of efficiency will result.

Importance of Constant Supervision

It is undeniable that the efficiency of any productive organization deteriorates rapidly without constant supervision; but during the period in which the National Agreement was in full force, adequate supervision of labor was impossible. Today this obstacle has been largely removed, and in starting to increase railroad shop efficiency, one important step would be to send out men to make thorough studies of conditions in each of the shops, with a view to establishing the normal cost of every operation and ascertaining the cause of failure to attain this degree of efficiency. In most cases it would probably be found that both mechanical equipment and labor are partially responsible for low efficiency.

A man who has had an unusual opportunity to observe conditions in railroad shops suggests that better results can be obtained from shop workers by creating a financial incentive, such as a properly applied piece-work or bonus plan of payment, which would be of benefit to both the men and the management; and he believes this idea could be carried still further by placing the shop foremen on a bonus system as well as the men.

A Plan for Increasing the Efficiency of Labor

In working out such a plan for rewarding the efficiency of the foremen, it would be necessary to determine what working force would normally be required in each department for handling the average amount of work coming into the shop. Then if this normal force could be reduced by increasing the rate of output per man, the foreman would be paid a percentage of the saving in labor costs of his department. The foreman would urge the men to obtain the maximum production by pointing out the increase in their earnings made possible by the bonus system. Such a plan would be far-reaching in its effect, because it would overcome the jealousy that is sometimes felt by foremen because of the high earning capacity of men who are working on a piece-work basis.

Efficiency in the management of any manufacturing enterprise requires the successful adjustment of three fundamental factors—methods, mechanical equipment, and men. Conditions in a railroad shop are not radically different from those in industrial plants handling similar classes of work; in both cases, to make it possible to machine parts at a minimum cost, it is imperative (1) to develop methods for performing each operation rapidly; (2) to make sure that a machine of the proper type and one that is in good mechanical condition is available for handling every job; and (3) to have the machine operated by a mechanic with the necessary experience and ability, who makes an effort to produce the high rate of output possible with the machine and methods used. The present article is an investigation into the extent to which railroad shops meet these requirements of efficient management.

TIME FOR PERFORMING MACHINING OPERATIONS ON LOCOMOTIVE PARTS

No. of Operation	Part to be Machined	Operation	Railroad No. 1 Santa Fe Type Engine		Railroad No. 2 Santa Fe Type Engine		Railroad No. 3 Mikado Type Engine		Railroad No. 4 Santa Fe Type Engine		Railroad No. 5 Heavy Mikado Type Engine		Railroad No. 6 Santa Fe Type Engine		Railroad No. 7 Santa Fe Type Engine	
			Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours
1	Cylinder casting	Bore cylinder	Horizontal boring mill	11.53	Horizontal boring mill	7.50	Special mch.	12.00	Special horizontal boring mill (bore and face cylinder)	25.00	Horizontal boring mill	9.00	...	...	Horizontal boring mill	30.00
2	Cylinder casting	Bore valve chamber	Horizontal boring mill	6.63	Horizontal boring mill	5.00	Special mch.				Horizontal boring mill	5.00	...	...	Horizontal boring mill	20.00
3	Piston-head	Face ends, turn outside diameter, cut two grooves and bore rod fit	Vertical turret lathe	2.60	...	...	Lathe	3.50	Boring mill	3.50	Vertical boring mill	8.00	Vertical turret lathe	5.50	Vertical turret lathe	4.00
4	Piston-ring	Turn and bore sleeve, and cut off rings	Vertical turret lathe	0.27	...	...	Vertical turret lathe	0.20	...	0.33	Vertical boring mill	0.28	Vertical turret lathe	0.48	...	0.33
5	Main-rod	Machine sides at each end	Planer type milling machine	1.76	...	...	Planer	3.00	Planer (Includes Operation 8)	6.00	Planer	11.00	Planer	4.00	Planer type milling mch.	8.00
6	Main-rod	Machine four sides of body, channel two sides	Planer type milling machine	9.53	...	...	Planer	12.00	Planer	12.00	Horizontal milling machine	12.00	Planer	16.00	Planer	16.00
7	Main-rod	Mill radius at small end	Vertical milling machine	3.13	...	...	Slotter	0.50	Vertical milling machine	1.00	Vertical milling machine	2.00	...	...	Slotter	3.00
8	Main-rod	Mill strap fit at large end	Vertical milling machine	6.97	...	...	Slotter	2.00	Included in Operation 5	...	Planer	1.00	Slotter	9.00	Draw cut shaper	3.00
9	Main-rod strap	Finish edges	Planer type milling machine	1.04	Planer	0.70	Planer	2.00	Planer	2.00	Planer	8.00	...	...	Planer	2.00
10	Main-rod strap	Mill or slot inside and out	Vertical milling machine	6.87	Slotter	3.80	Slotter	6.00	Slotter	6.00	Slotter	15.00	Slotter	8.50	Slotter	5.00
11	Main-rod brass	Face joints	Engine lathe	0.44	Shaper	0.50	Shaper	0.17	Planer type milling machine	0.50	Shaper	0.50	Engine lathe	0.50	Shaper	0.50
12	Main-rod brass	Sweat together	...	0.23	...	...	...	0.17	...	0.33	Coke furnace	0.25	...	0.50	...	0.50
13	Main-rod brass	Face both ends	Engine lathe	0.11	...	...	Shaper	0.17	...	0.33	Vertical boring mill	0.50	Engine lathe	0.50	Boring mill	0.50
14	Main-rod brass	Machine strap fit	Crank planer	1.11	Miller	1.50	...	1.67	Slotter	4.00	Shaper	3.00	Shaper	1.50	Shaper	2.00
15	Main-rod brass	Bore hole	Vertical boring mill	1.11	Vertical boring mill	0.90	Vertical boring mill	0.67	(Bore and face one side)	1.50	Vertical boring mill	1.00	Engine lathe	1.25	Vertical boring mill	1.50
16	Driving wheel center	Turn outside diameter	Vertical boring mill	7.38	Wheel lathe	4.00	Vertical boring mill	3.00	(Turn, bore axle fit, face sides)	14.00	Wheel lathe	2.50	...	...	Wheel lathe	4.00
17	Driving wheel center	Press on axle	Hydraulic press	0.30	Hydraulic press	2.00	600-ton press	0.67	...	1.50	Hydraulic press	1.00	Hydraulic press	1.00	Hydraulic press	1.00
18	Wheel center	Quarter	Quartering mch.	0.94	Quartering mch.	3.50	Quartering mch.	1.50	...	4.00	Quartering mch.	3.50	...	...	Quartering mch.	2.00
19	Driving wheel tire	Bore inside diameter	Vertical boring mill	3.20	Vertical boring mill	1.00	Vertical boring mill	0.67	...	1.00	Vertical boring mill	0.67	...	...	Vertical boring mill	1.25
20	Driving wheel tire	Shrink on center	Special heating furnace	0.70	Special heating furnace	1.20	Unit heater	0.33	Kerosene oil burner	0.67	Oil heating device	0.50	Special heating furnace	1.25	Special heating furnace	0.50
21	Driving wheel tire	Turn tread and flange	Wheel lathe	0.63	Wheel lathe	1.12	Wheel lathe	0.50	Tire turning machine	0.83	Wheel lathe	1.50	Wheel lathe	2.50	Wheel lathe	2.67
22	Main crankpin	Turn all over	Engine lathe	4.17	Engine lathe	4.00	Engine lathe	4.47	...	6.00	Engine lathe	15.00	Engine lathe	6.50	Engine lathe	7.00
23	Main crankpin	Press into wheel	Hydraulic press	0.22	Hydraulic press	1.50	600-ton press	0.17	...	0.50	Wheel press	0.50	Hydraulic press	0.50	Hydraulic press	0.25
24	Driving-box	Face hub face and opposite end	Horizontal milling machine	0.96	Vertical boring mill	1.50	Vertical milling machine	2.00	Vertical boring mill	3.50	Planer	1.50	Planer	2.00	...	...
25	Driving-box	Slot brass fit	Slotting mch.	1.57	Slotting mch.	3.30	Slotter	2.50	Slotter	4.50*	Vertical slotter	3.00	Slotting mch.	2.25	Slotting mch.	3.00
26	Driving-box	Slot cellar fit	Slotting mch.	0.77	Slotting mch.	1.20	Slotter	1.00	Slotter		Vertical slotter	1.50	Slotting mch.	1.50	Slotting mch.	1.00
27	Driving-box	Machine shoe and wedge fits	Horizontal milling machine	2.28	Planer	5.00	Planer	5.00	Planer	4.00	Planer	3.00	Planer	3.50	...	...

Machinery

*Operations 25 and 26 performed at one setting on the slotter.

TIME FOR PERFORMING MACHINING OPERATIONS ON LOCOMOTIVE PARTS—(CONTINUED)

No. of Operation	Part to be Machined	Operation	Railroad No. 1 Santa Fe Type Engine		Railroad No. 2 Santa Fe Type Engine		Railroad No. 3 Mikado Type Engine		Railroad No. 4 Santa Fe Type Engine		Railroad No. 5 Heavy Mikado Type Engine		Railroad No. 6 Santa Fe Type Engine		Railroad No. 7 Santa Fe Type Engine	
			Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours
28	Driving-box	Plane dovetailed groove in shoe and wedge faces	Draw-cut shaper	1.03	Planer	1.50	Planer	1.00	(Dovetails cast in box)	....	....	....	Shaper	1.50	Draw-cut shaper	1.00
29	Leading driving-box	Recess hub for lateral bearing brass..	Vertical boring mill	2.36	Vertical boring mill	0.70	Vertical boring mill	0.50	....	....	Vertical boring mill	1.50	Vertical boring mill	3.25	Vertical boring mill	1.50
30	Trailing driving-box	Recess hub for lateral bearing brass..	Vertical boring mill	0.86	Vertical boring mill	0.60	Vertical boring mill	0.50	....	....	Vertical boring mill	1.50	....	....	Vertical boring mill	3.00
31	Main driving-box	Cast brass liners on shoe and wedge faces and hub.......	Special fixture	1.69	Special fixture	0.50	Special fixtures	1.00	....	1.00	....	....	....	....	(Liners riveted in place)	3.00
32	Other driving-boxes	Cast brass liners on shoe and wedge faces and hub.......	Special fixture	1.24	Special fixture	0.50	Special fixtures	1.00	....	0.75	....	....	....	....	(Liners riveted in place)	3.00
33	Main driving-box	Plane shoe and wedge faces	Crank planer..	3.32	Planer	1.30	Planer	1.00	Bed planer....	3.00	Planer	1.00	Planer	3.25	Planer	2.00
34	Other driving-boxes	Plane shoe and wedge faces	Crank planer..	1.16	Planer	1.80	Planer	0.33	Bed planer ...	1.50	Planer	0.67	Planer	1.50	Planer	2.00
35	Main driving-box	Bore axle fit and face hub bearing....	Vertical boring mill	2.82	Vertical boring mill	1.40	Vertical boring mill	0.50	....	3.50	Boring mill....	1.00	Vertical boring mill	2.50	Vertical boring mill	2.50
36	Other driving-boxes	Bore axle fit and face hub bearing.. .	Vertical boring mill	1.23	Vertical boring mill	1.40	Vertical boring mill	0.50	Car-wheel boring mill	1.00	Boring mill....	0.67	Vertical boring mill	1.25	Vertical boring mill	2.00
37	Driving-box	Drill dowel, and cellar pin-hole and oil-hole	Vertical drilling machine...	1.81	Vertical drilling machine...	1.20	Radial drilling machine	0.58	Radial drilling machine	0.33	Drilling machine	1.00	....	....	Vertical drilling machine ..	1.50
38	Main driving-box	Assemble	....	3.51	....	1.70	....	....	....	2.50	Pneumatic press	1.00	....	4.50	....	3.00
39	Other driving-boxes	Assemble	....	1.48	....	1.70	....	....	....	1.75	Pneumatic press	1.00	....	1.50	....	3.00
40	Main driving-box	Fit and apply to wheels	....	2.56	....	1.90	....	0.50	....	0.83	....	1.50	....	3.25	....	2.00
41	Other driving-boxes	Fit and apply to wheels	....	0.53	....	1.60	....	0.50	....	0.50	....	1.50	....	1.25	....	1.50
42	Driving-box brass	Turn box fit.........	Engine lathe..	0.56	Engine lathe..	1.00	Engine lathe...	0.50	....	0.42	Vertical boring mill	1.00	Engine lathe..	0.50	Boring mill....	0.50
43	Driving-box brass	Shape box fit........	Shaper with rotary attachment	0.23	Shaper with rotary attachment	0.70	Shaper	0.50	....	0.33	Shaper	0.33	Planer	1.00	Shaper	0.25
44	Shoe	Machine all over....	Horizontal milling machine	0.53	Planer	2.10	Planer	1.50	Bed planer.....	0.75	Planer	0.50	Shaper	1.00	Planer	1.50
45	Wedge	Machine all over....	Horizontal milling machine	0.53	Planer	2.00	Planer	1.50	Bed planer.....	0.75	Planer	0.50	Shaper	1.00	Planer	1.50

Machinery

To successfully apply such a system, the investigators who establish what constitutes a normal working force for each department must keep constantly in mind the fact that it is not the purpose to impose an unnecessary or unjustifiable amount of work upon any employe, but merely to have all the men in every department kept constantly employed during working hours. Frequently a machinist sets up a job and starts his machine on an operation which takes a considerable time to complete, and on which the machine works automatically until the job is finished. Under such conditions the mechanic is idle until it is time for him to remove a finished piece from the machine and set up another.

All such causes of lost efficiency should be overcome by providing other work for the man to do, such as operating a second machine engaged on the same work, or performing some other operation on the pieces that he is machining. This would afford an opportunity for the workman to earn more money, it would effect a saving for the railroad by reducing the number of men employed in the shop, and with a bonus system of the kind mentioned, it would allow the foreman of the department to earn a bonus.

Comparative Data on Railroad Shop Costs

With a view to emphasizing the importance of investigating the costs of handling railroad shop work and of correcting the causes of low efficiency, an investigation has been conducted by MACHINERY to ascertain the time required for performing a number of machining operations regularly handled in practically all such shops throughout the country. As might have been expected, these figures show a wide divergence, and their lack of uniformity shows that many of the shops are paying out large sums of money for labor, which could be saved if better mechanical equipment were used and the efficiency of machinists were greater. Those railroad shop managers who are dissatisfied with the results they are securing would do well to investigate immediately all conditions that exist in their plants. This would probably uncover many unsuspected sources of loss in even the best managed shops; and even where substantial expenditures were required for the necessary equipment, the new machines would earn a satisfactory return, because of their greater output and the reduced amount of labor required.

A typical instance will prove this statement. In machining the edges of main driving-rod straps, one shop handles this job on a planer and takes eight hours to finish one piece, while another shop handles the job on a planer type milling machine and finishes a piece in 1.04 hours. This means a loss to the first shop of 6.96 hours per piece, and allowing 77 cents per hour for labor, the equivalent in money is $5.36 per piece. Any shop that has a large number of main driving-rod straps to mill would find an investment in a milling machine to be well worth while; such a machine could also be used for other operations besides the one mentioned.

In collecting the figures in the accompanying table, an effort was made to include shops where the conditions are regarded as good, fair, and poor. This gives a representative survey of the conditions existing in railroad shops. Six of the shops are located in the United States and one in Canada. These data were collected for MACHINERY through personal investigations in the various shops made by a man who was for a number of years the superintendent in charge of a well-known American railroad shop.

Causes of Failure to Obtain Normal Efficiency

In collecting these figures, an effort was made to ascertain the cause of trouble in cases where the time required to handle a job was much above what is believed to be a normal average. Although there were exceptions to the general rule, in the majority of cases it was found that the method of tooling up each machine for its work had been modernized as far as possible, so that the fault was usually either with the type or condition of the machine that was used or with the efficiency of the man assigned to the job. These two causes of inefficiency were about equally balanced.

Another interesting point developed during the course of this investigation was that in some shops where the average of conditions was very bad, certain operations were performed with an unusual degree of efficiency. A case in point is the machining of piston-heads where it is required to face the ends, turn the outside diameter, cut two ring grooves and bore the rod fit. In one shop where the general condition of the machinery is very poor and where the efficiency of the working force is equally unsatisfactory, this particular job is completed in a very reasonable time. This fact is the more noteworthy when it is borne in mind that the working force in this shop has been very hard to handle. The reason that the present job is so successful is not hard to find. A modern type of vertical turret lathe was bought for this machining operation, and it was carefully tooled up to enable the various steps in the complete operation to be handled in such a way that several tools are often working at the same time. The investment in this equipment is earning a very satisfactory return.

Wide Variations in Results Obtained by Different Shops

In looking over the comparative figures for various railroad shop operations, it will be seen that in many cases there is a wide variation in time, even though the type of machine on which the work is done is practically the same. In many such instances the explanation lies in the method of handling the work while setting up and removing it from the machine, or in some advantage secured through the provision of efficient auxiliary equipment. Another point which in some cases is responsible for the difference in results is that one shop adopts the modern manufacturing practice of setting up a number of pieces to be machined in a single operation, while another shop adheres to the old plan of handling one piece at a time. In order to bring its costs down to a normal average, the railroad shop must give the same care that the progressive industrial plant does to the perfection of every detail of manufacture.

Independent Contract Shops for Repair Work

In making repairs on locomotives and cars, each railroad shop bears somewhat the same relationship to the corporation which it serves that an entirely independent concern would, which had an absolute monopoly on the class of service the railroad desired to purchase. In other words, there is no competition, and consequently no stimulus toward higher efficiency and lower costs.

With a view to avoiding the limitations of efficiency set up by the terms of the National Agreement, eight railroads in the United States have, up to the present time, placed one or more of their car repair shops under the control of contractors who handle the work along strictly commercial lines. This plan has a number of advantages. In the first place, the contractor always realizes that his methods must be kept up to date and that he must take advantage of all possibilities of reducing production costs in order to hold the work against bids of competing organizations. Also, the independent contractor would not be hampered by many of the burdensome regulations that are still imposed by the United States Railroad Board.

In some quarters it is the belief that this constitutes the real solution of the railroad shop problem, and those who hold to this belief are inclined to advocate the idea of applying the same principle in handling locomotive repair work. The solution of the railroad shop problem is of the greatest importance, because the railroads exert a general and important effect upon the business and prosperity of the country.

There is no question about the urgent need of rehabilitating means for maintaining railroad equipment in an efficient operating condition. The problem is to decide which method is the more satisfactory—to continue operating the shops as a department of the railroads or to place them under independent control. If the former expedient is adopted, each railroad must conduct a thorough housecleaning; and if the shops are placed on an independent commercial basis, the same course of action would follow as a matter of course, because no experienced manufacturer would expect to be able to get results with the inefficient labor and obsolete equipment that are found in many railroad shops at the present time.

* * *

REDUCING THE COST OF JAPANNING

By HUGO A. BIESEN

In order to reduce production costs, the Cutler-Hammer Mfg. Co., Milwaukee, Wis., has adopted a new practice in connection with the japanning of machine parts. In the past this operation was performed after the castings had been machined. They were then sent to the japanning department where a hand painting or spraying operation was performed. This resulted in the japan partly covering the machined surfaces, and it was practically impossible to keep the japan from clogging tapped or reamed holes. When these castings arrived in the assembly departments it was invariably necessary to again tap and ream the holes clogged by japan. With the idea of eliminating this duplication of operations, the feasibility of performing the painting operation before machining was carefully considered. As a result a change in the sequence of operations was made, and at present all castings are sent to the japanning department before being machined.

This reversal of operations entirely eliminates the necessity of reaming or tapping holes twice, and leaves all machined surfaces clean and free from japan. The greater amount of care required in handling and machining castings already japanned does not offset the saving which results from elimination of the operations required to remove the japan from machined holes and surfaces.

The cost of japanning castings has also been reduced by an appreciable percentage in consequence of this change in procedure, since it is now possible to apply the japan by the dipping method, whereas it was formerly necessary to apply it by means of a hand brush or spray.

PROFILING FIXTURE

When profiling operations are of such a nature as to require more than one former for guiding the cutter, as when milling different curved surfaces at one setting of the work, several methods may be used in designing the profiling fixture to permit locating two or more former plates successively in the working position. One method is to use pivoted formers, which are swung around to the working position, one after the other, for controlling the path followed by the guide pin when taking separate cuts that cannot be controlled by one former. This plan has often been adopted when two former plates of different curvature are required, the second former being swung into the working position, as determined by a stop, after completing the cut controlled by the first former.

Another method is to use a single pivoted former which has two or more slots cut in it, or possibly plates attached to it, instead of using independent plates. The different slots or outlines formed on the single pivoted plate are successively brought to the working position opposite the guide pin as the former plate is indexed from one position to the next. With this arrangement a locating plunger or pawl may be used in conjunction with suitably located notches for governing the positions of the former plate.

The fixture shown by the assembly drawing Fig. 1, and on the profiler in Fig. 2, has an indexing former slide for locating the different formers in the working position, but in this design the slide has a lengthwise movement. The slide *A* is mounted in dovetailed ways extending across one side of the fixture. Beneath the slide there is a locating strip *B* containing as many notches *C* as there are former plates. These notches are engaged by plunger *D*, which is withdrawn for indexing the slide by means of handle *E*.

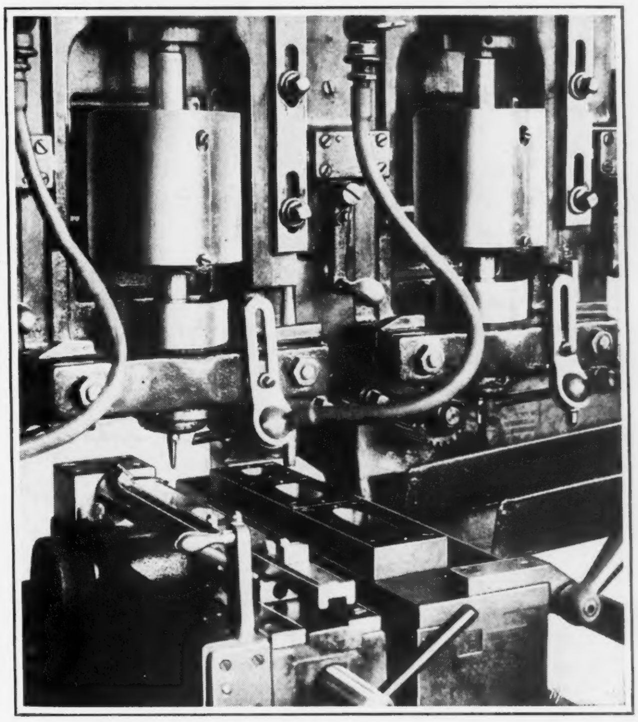


Fig. 2. Profiling Fixture equipped with Indexing Slide for locating Three Different Formers in the Operating Position

Handle *E* is connected to the end of shaft *F*, which has a groove extending throughout its length. This groove is engaged by a tooth on part *G*, which is connected with plunger *D*; hence slide *A* can be moved to any position and the locating plunger is always under the control of handle *E*. The groove in shaft *F* is formed by using a regular 6-pitch No. 8 gear-cutter, and the tooth on part *G* is milled by using a 6-pitch rack-cutter. Whatever former plates are required are attached to the top of the indexing slide, as shown in Fig. 2, which represents a profiling operation on the receiver of a rifle. The work-holding part of the fixture (see Fig. 1) consists of a quick-acting vise operated by a cam-lever *H*. The vise jaws are modified, of course, to suit the work. This design of fixture is frequently employed by the Pratt & Whitney Company whenever it is required to use more than one former.

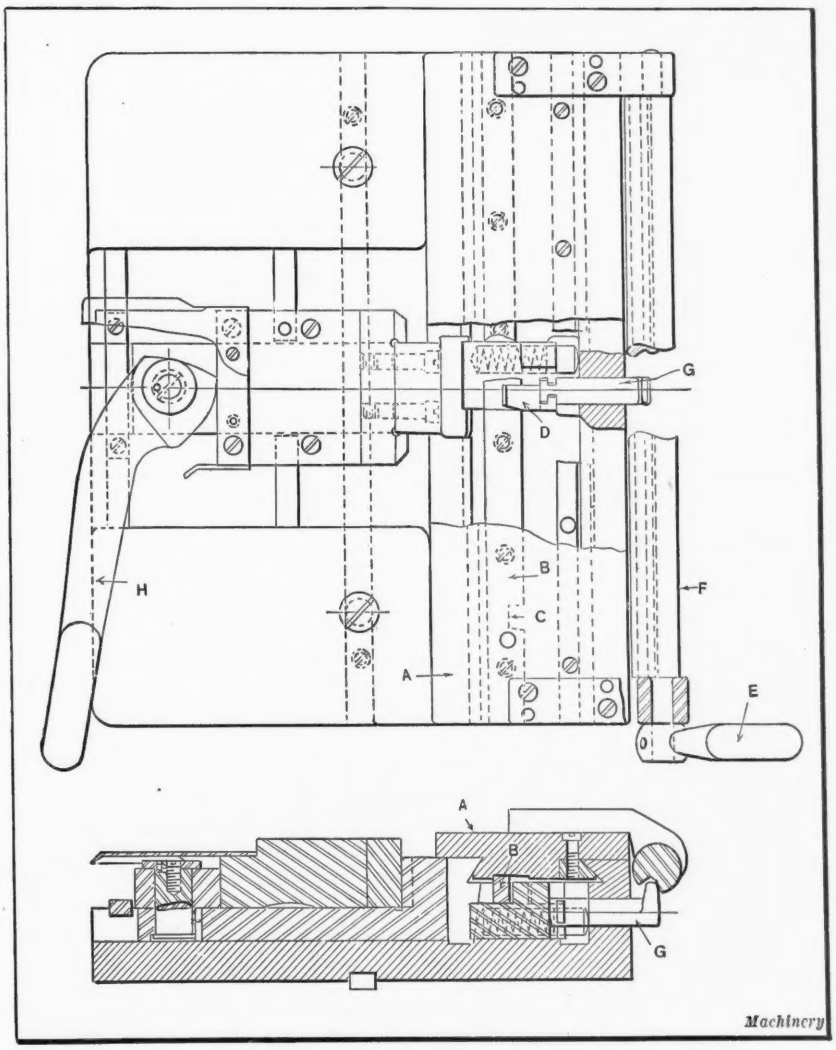


Fig. 1. Sectional and Plan Views of Profiling Fixture shown in Fig. 2

* * *

The advantages of standardization are summarized by the Chamber of Commerce of the United States as follows:

Easier financing and less capital tied up in raw, semi-finished, and finished materials, unnecessary equipment and extra storage floor space.

More economical manufacture on account of longer production runs with fewer changes; increased individual production; less idle equipment; reduced expenditure for clerical work and cost accounting.

More efficient labor, through greater stability and permanence of employment, because of the increase in skill due to repetitive processes in longer runs, and consequently increased earnings.

Better quality of product; prompter deliveries and increased efficiency in packing for shipment.

More efficient selling forces.

Increased rate of turnover.

Charts for Determining Belt Widths

By THOMAS J. COOK

MORE often than otherwise the success of an undertaking depends upon the careful study and working out of details which at first do not seem worthy of much consideration. This is especially true of belt transmission installations. Too often when installing a new belt, the width is selected without regard to the various factors that must be considered if the most efficient operating conditions are to be obtained. Sometimes a certain width is used simply because it can be carried on the face of the smaller pulley. A belt thus selected is frequently accepted as satisfactory simply on the grounds that it transmits the required horsepower.

For at least two reasons it is as great a disadvantage to employ a belt that is too wide or too thick as it is to employ one that lacks either width or thickness sufficient to supply the power demanded of it. If the size of the belt is in excess of what is actually required, the cost will be unnecessarily high. Another unnecessary expense of possibly more vital importance than the first is the extra driving power required. Although the extra power consumed in driving one belt may be very slight, it will perhaps, when multiplied by the number of belts installed in the plant, amount to an unnecessary overload for the power house that will be reflected in an equally unnecessary overhead expense.

Centrifugal force is a factor that must be taken into consideration in installing belting, especially in those cases in which the conditions demand a high speed. Up to a belt speed of 2000 feet per minute, this force need not be taken into consideration, but when the belt exceeds this speed it becomes a vital factor. If a belt is used that is either too wide or too thick, the centrifugal force becomes excessive, and the belt will have an increased tendency to continue in a straight line tangent to the face of the pulley instead of continuing in its true path about the circumference. As the centrifugal force increases the belt becomes looser on the pulley, which results in a marked decrease in the friction driving force. The lessening of the frictional driving force or the tendency of the belt to slip must therefore be overcome by increasing the tension of the belt. An increase in the tension is of course objectionable, as it materially reduces the life of the belt.

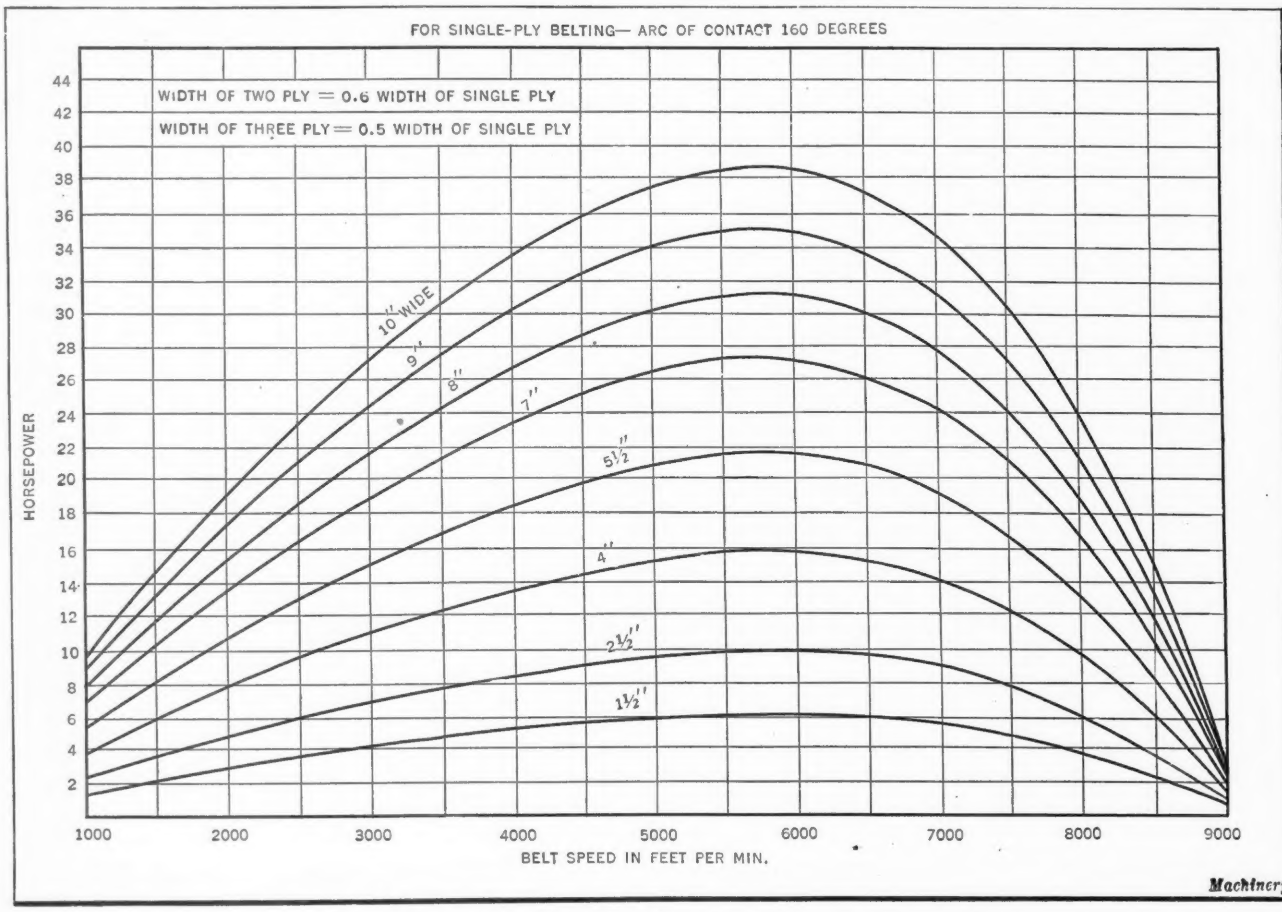


Fig. 1. Chart for determining Belt Widths when Pulleys are of Unequal Size

While there are many formulas that may be used to calculate the correct belt size for any condition, they all involve more or less tedious mathematical operations. Tables have been evolved which eliminate the necessity of making calculations to determine the proper size of belt to use under certain conditions, and many of these can be used with excellent results. To relieve those who are frequently called upon to determine the correct widths for belts, of the difficulties which may arise in making the required calculations, and to provide an even simpler medium than tables, the writer has devised the accompanying charts, which should enable anyone to ascertain at a glance the most efficient size of belt to be used for any condition which may arise.

The arc of contact of the belt on the smaller pulley must always be taken into consideration in determining the horsepower that a belt can transmit. The chart shown in Fig. 1

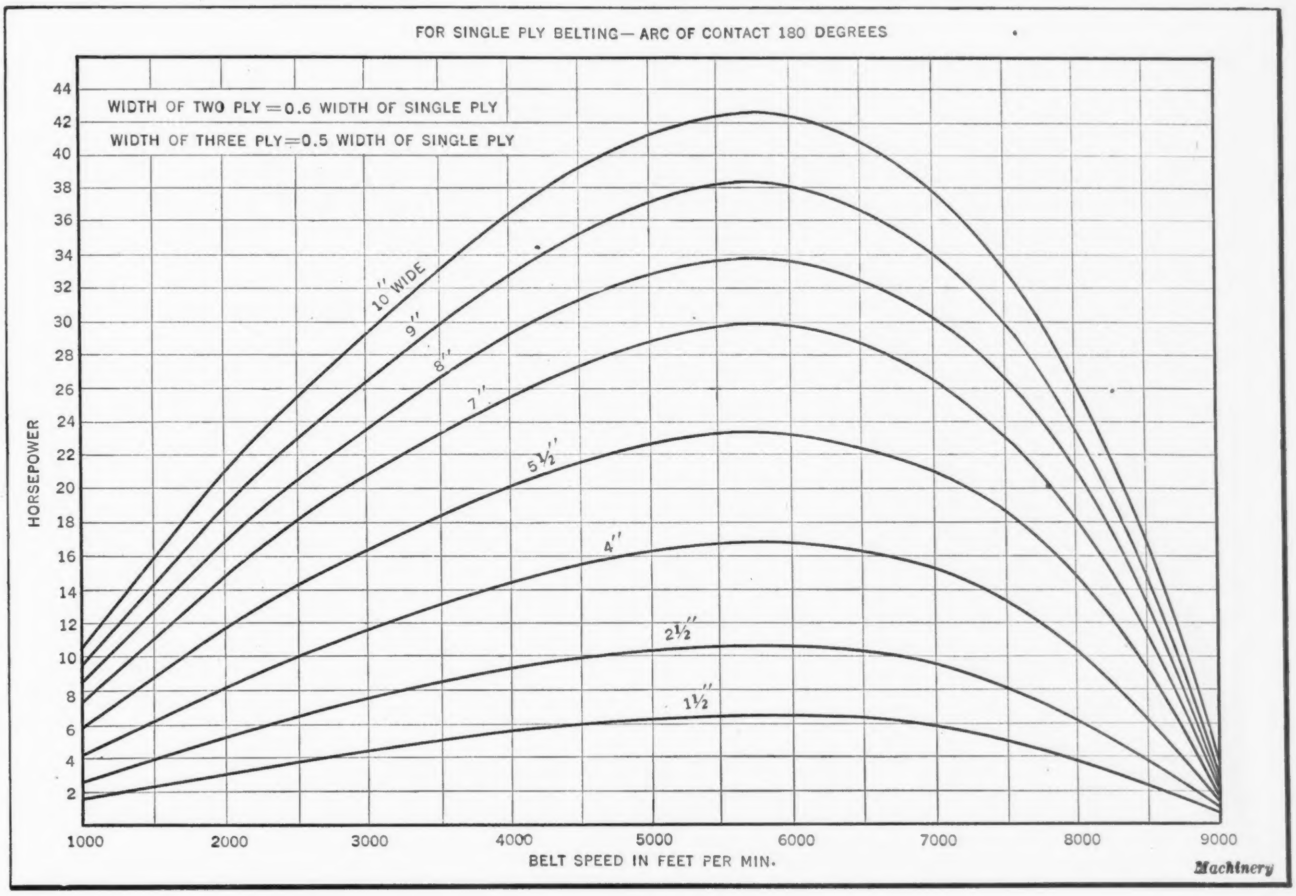


Fig. 2. Chart for determining Belt Widths when Pulleys are of Same Size

is for use when the arc of contact of the belt on the pulley is approximately 160 degrees. This chart is therefore suitable for use in the case of open belts where one pulley is smaller than the other. The chart shown in Fig. 2 is intended for use in the case of open belts where both pulleys are of the same size, that is, when the arc of contact is 180 degrees. The chart shown in Fig. 3 may be used in the case of cross belts, although such an installation is to be

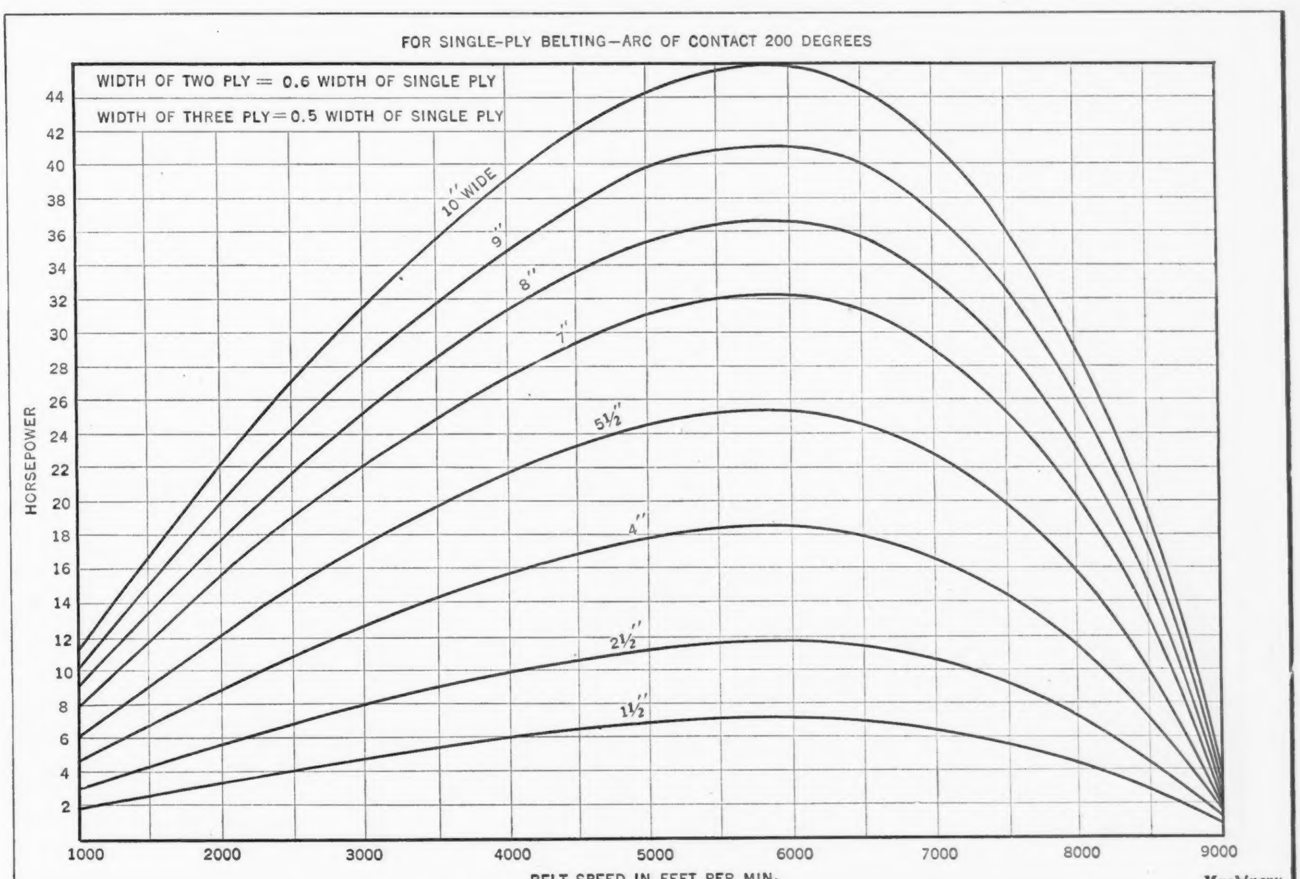


Fig. 3. Chart for determining Belt Widths when Cross Belts are used

avoided if possible on account of the increased wear, which shortens the life of the belt.

To illustrate the use of the charts, let it be required to find the size of a belt which is to transmit 42 horsepower running at a surface speed of 5500 feet per minute over pulleys of equal diameter having 8-inch faces. First locate on the 180-degree chart, Fig. 2, the point of intersection of the vertical line representing a surface speed of 5500 feet per minute, and the horizontal line representing a driving force of 42 horsepower. This point of intersection occurs about on the 10-inch curve or the curve representing a belt width of 10 inches. Thus, a 10-inch single-ply belt would transmit 42 horsepower. However, the pulleys have 8-inch faces so that a 10-inch belt could not be used. According to the note in the upper left-hand corner of the chart, the width of a two-ply belt of the same capacity as a single-ply belt is obtained by multiplying the width of the single-ply belt by 0.6. As $0.6 \times 10 = 6$, a 6-inch double-ply belt will therefore be the proper installation.

An 8-inch face pulley required to transmit 42 horsepower is an extreme case, but the example serves to show the application of the chart. The width of a belt can often be read direct from the curves. Every point on each curve shown on the chart was calculated separately, use being made of a well-known belting formula in which allowance is made for the effect of centrifugal force.

An inspection of the charts will disclose some interesting and important facts relative to the proper installation of belts. It will be noted that the curves continue in a straight line until they reach the vertical line representing a speed of 2000 feet per minute. This bears out the statement that centrifugal force does not have any noticeable effect until the belt runs in excess of 2000 feet per minute. At this point the curves begin to diverge from a straight line, gradually at first, and more rapidly as the speed increases, but always in an upward path, until the peak of the curves is reached between 5500 and 6000 feet per minute. This, therefore, may be said to be the efficient belt speed, but in actual practice a somewhat slower speed should be used.

Beyond a speed of 6000 feet per minute the centrifugal force becomes so great that the curves on the chart fall rapidly, indicating that the pulley is subject to more or less slippage with a consequent loss of power. This emphasizes the fact that no belt should be allowed to run over 6000 feet per minute. At the line representing a speed of 9000 revolutions per minute, the curves so nearly run out at the zero power line that it is evident that at this speed the belt will continually slip on the pulley and practically no power will be transmitted. Belt widths of 1½, 2½, 4, 5½, 7, 8, 9, and 10 inches have been selected in making up the charts, because by multiplying or factoring these widths it is possible to obtain a greater range of widths. For example, to find the horsepower that can be transmitted by a 3-inch single-ply belt running at 4000 feet per minute over pulleys of equal size, it is only necessary to use the 1½-inch curve of the chart shown in Fig. 2 and multiply the value given by 2. From this chart it will be found that a 1½-inch belt running under the given conditions will transmit 5.6 horsepower. Therefore a 3-inch belt will transmit 2×5.6 horsepower or 11.2 horsepower.

GENERAL-PURPOSE MILLING FIXTURES

By A. J. CAYOUETTE

Standardizing certain types of milling fixtures is a practical and economical practice, and has proved especially so in the manufacture of firearms. Milling fixtures of standard design are suitable for use in a wide variety of manufacturing. Designing milling fixtures which are simple in construction, strong, quick-acting, and which can be adapted for holding a large range of work will greatly reduce the costs and the time required for doing tool work. The designs of milling fixtures described in this article have been standardized to such an extent that many of the parts were made up and are kept in stock so that fixtures may be built up in a short time and at a lower cost than would be involved if a special holding fixture were required for each new piece of work.

The fixture shown in Fig. 1 has proved practical to standardize, and is an efficient tool for handling a variety of work. The range of the fixture can be extended by providing jaws to suit the contour of the part to be machined. The work is held between the stationary jaw *E* and the movable jaw *F*, the stationary jaw being fixed to the base of the fixture by dowel-pins and screws and located by a tongue and groove, while the movable jaw swivels on stud *G* which is carried in slide *D*. This slide is operated in a slot in the base of the fixture, as shown in the sectional view.

The work is securely clamped to the stationary jaw by operating the eccentric lever *B*, which is free to pivot about the fixed stud *C*, carried in the opposite end of slide *D*. Tool-steel plates, one attached to the base of the fixture and the other to the jaw *E*, provide bearing surfaces against which the eccentric lever operates, thus reducing wear and increasing the length of service of the fixture.

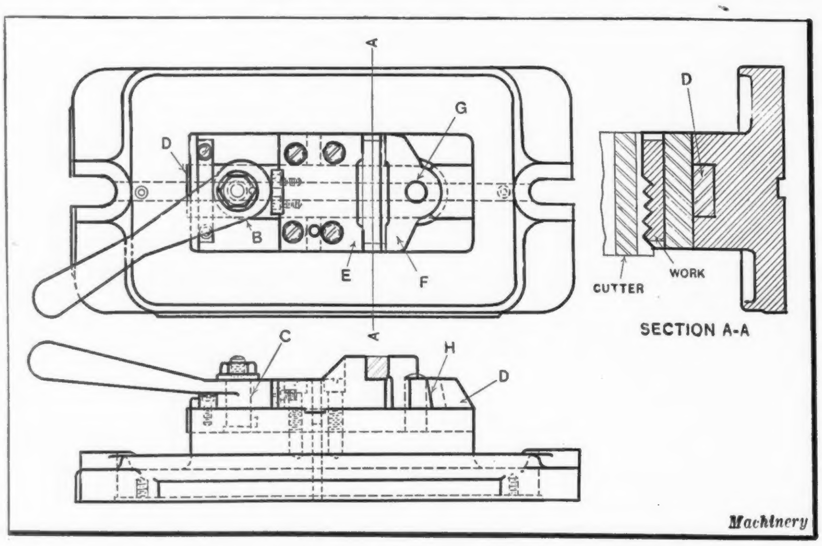


Fig. 1. Milling Fixture which will accommodate a Variety of Work

By making the movable jaw *F* so that it can swivel, the clamping pressure is equalized on the work. Surface *H* of this jaw is angular, and fits a corresponding surface at the rear of slide *D*, which prevents the jaw from lifting when the clamping pressure is exerted. The base of this fixture, as well as of the other fixtures illustrated in this article, is made of cast iron, and is molded to form a reservoir for lubricants and coolants employed in the milling operation. The reservoir is provided with a drain hole so that the liquid may flow back to the supply tank.

The fixture illustrated in Fig. 2 is designed to hold two pieces of work at a time, one set of jaws being stationary with regard to the plane in which they operate, while the other half of the fixture contains a clamping unit, the jaws of which may be raised or lowered to compensate for differences in the diameter of the two cutters that might result from wear. This fixture has all the advantages of that shown in Fig. 1 as regards rigidity and simplicity of operation, and the stationary half of the fixture is identical in construction with the one just described. The feature that permits vertical adjustment of the clamping jaws also enables this tool to be used (with the employment of properly designed jaws) on work which is slightly different in design but on which similar milling operations are to be performed.

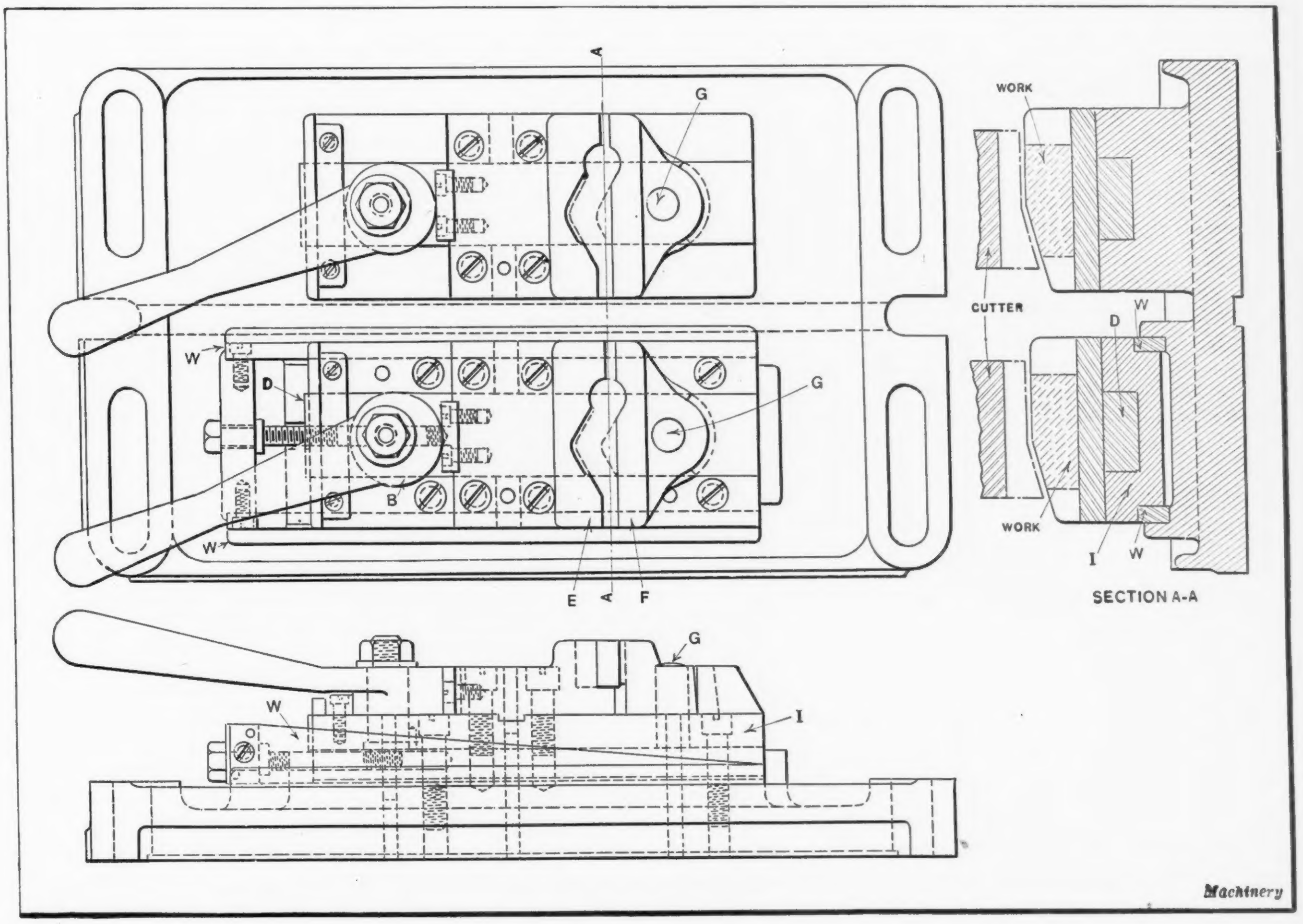


Fig. 2. Duplex Milling Fixture with Provision for adjusting the Vertical Position of One Holding Unit

The construction of the adjustable side of the fixture is, of necessity, a little different from the stationary side. The fixed jaw *E* is attached to a steel block *I* by a suitable tongue and by the use of dowel-pins and machine screws, after the general manner of attaching the fixed jaw to the base in Fig. 1. Slide *D*, therefore, operates in a suitable groove in this block, instead of in the base of the fixture itself. This steel block rides on two hardened steel wedges *W* which are fitted into the base on each side and provide the angular bearing surfaces by means of which the clamping part of the fixture is elevated.

After the proper vertical adjustment is obtained, the block *I* is fastened to the base of the fixture by screws and dowel-pins, as shown. The wedges extend beyond the travel of block *I*, and their ends are joined by a piece in which are carried the adjusting screw and lock-nut used in obtaining the adjustment. This raising or lowering of the block *I* carrying the clamping jaws can be readily effected by the

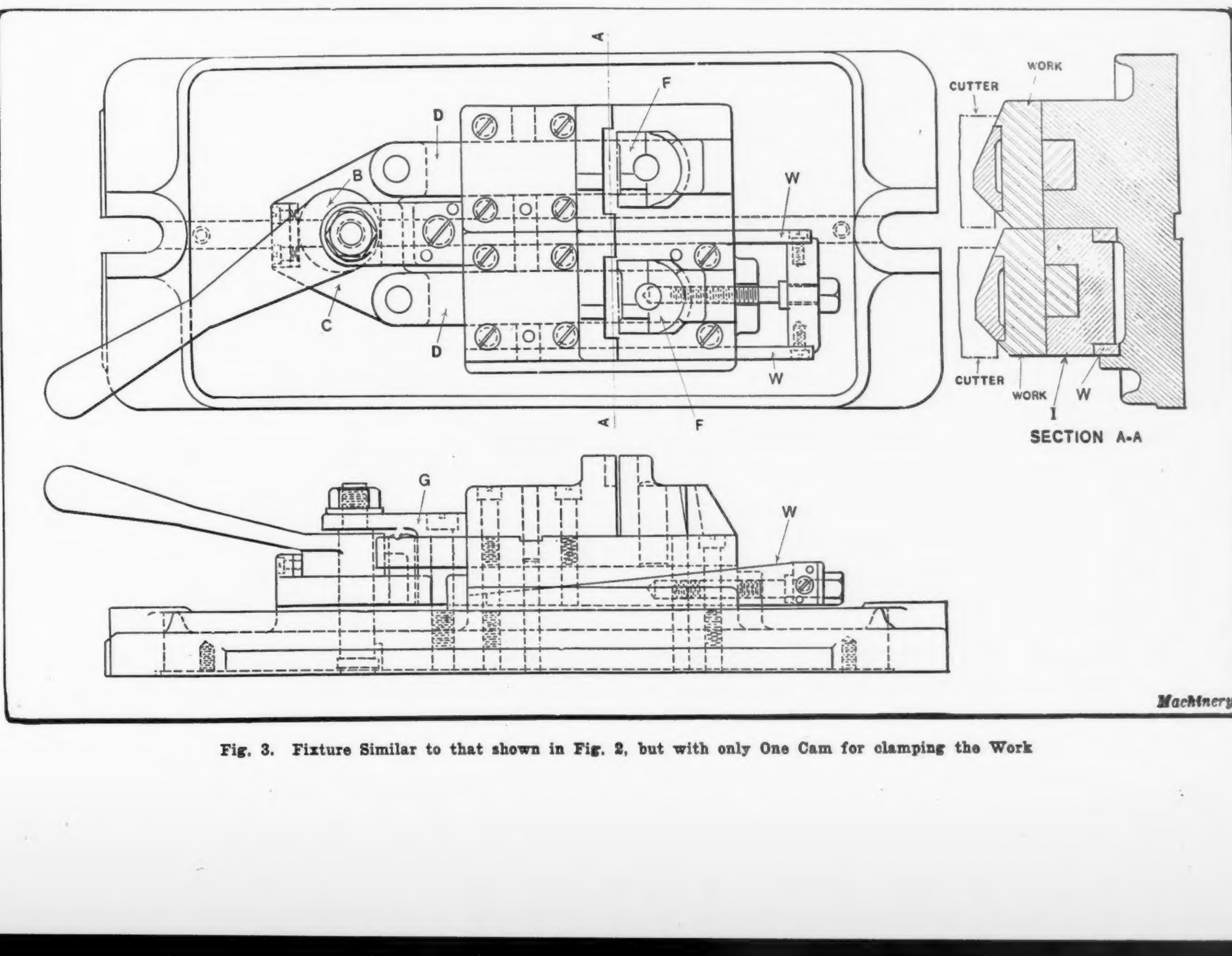


Fig. 3. Fixture Similar to that shown in Fig. 2, but with only One Cam for clamping the Work

simple means provided. The mounting of the jaw *F* is similar to that shown in Fig. 1, except that block *I*, instead of the base of the fixture, carries the stud *G* about which the jaw swivels. The eccentric lever *B* swivels on a stud attached to the base of the fixture and bears against steel pieces, similar to the construction employed in the fixture shown in Fig. 1 and in the stationary part of this fixture.

A somewhat lighter type of duplex milling fixture than that shown in Fig. 2 is illustrated in Fig. 3. The two sets of jaws are operated by a single eccentric lever, which enables a quicker clamping action to be obtained. This fixture also has one side designed to be independently adjusted in a vertical direction; the other side is stationary and designed according to the standards already outlined. In the design of this fixture the wedges *W* extend at the opposite ends of the steel block *I*, but are connected, similar to the construction employed in the fixture shown in Fig. 2, by a steel connecting piece in which the adjusting screw is carried. The two slides *D* are linked together by an equalizer *C*, which is free to swivel on the stud carrying the eccentric lever *B*, the latter being fixed in the base of the fixture. This equalizer is a yoke casting which, being free to swivel, enables the movable jaws *F* in each clamping unit to adjust themselves to any variation in the width of the work. The stud about which the eccentric lever swivels in clamping and releasing the work is reinforced at the top by a strap *G*, against the thrust exerted in operation. The other features of the fixture are the same as described in connection with the other two fixtures.

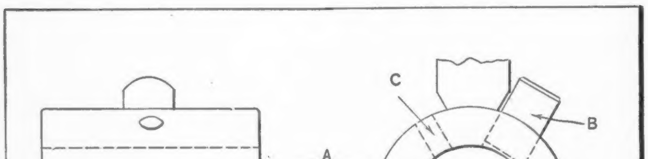
* * *

BRONZE BUSHING FOR STEADYREST

By H. H. PARKER

A bronze bushing *A* which can be clamped in the jaws of a lathe steadyrest, as indicated in the accompanying illustration, will prevent scratching or otherwise injuring the finished surfaces of spindles or shafts while facing their ends. When a large number of spindles of the same diameter are to be end-faced, this device is particularly useful, as it eliminates the necessity of placing pieces of flat leather or other material around the work to prevent the regular jaws of the steadyrest from scratching or marring the finished surfaces.

The bushing should be of bearing bronze, and reamed to fit the spindles or work to be faced. To prevent the bush-



Bronze Bushing for Lathe Steadyrest

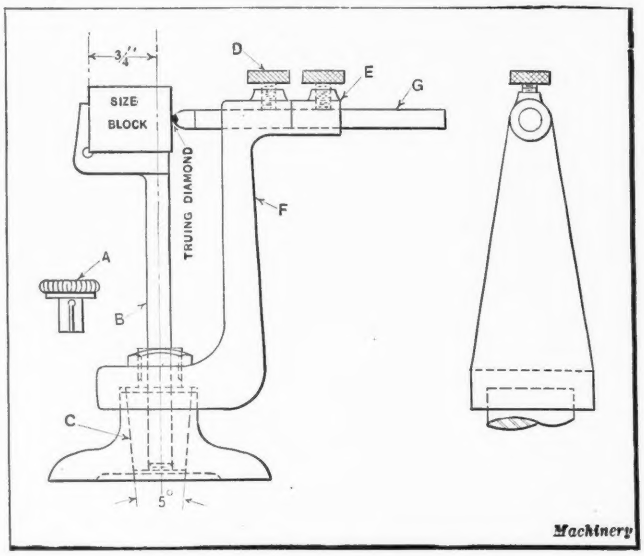
ing from rotating in the steadyrest jaws, a hole is drilled in the side and a brass stop-pin *B* driven tightly into this hole. The pin is brought up against the side of the top jaw and thus prevents rotation of the bushing. On the other side of the bushing, near the top, is located an oil-hole *C*. An oil-groove is also chipped out inside the bushing. When the bushing becomes worn it can be split, pressed together slightly, a bronze shim *D* fitted in the slot, and the hole again reamed to fit the work. After this treatment the steadyrest jaws will prevent the bushing from spreading, and it will be a good running fit on the work.

RADIUS WHEEL TRUING DEVICE

By WILLIAM C. BETZ

The device shown herewith is designed for truing the grinding wheels used in grinding beads or grooves on punches, dies, gages, and similar work. The fixture is made of tool steel, the swivel stud and base being hardened, and the tapered hole and stud ground and lapped. As the tapered stud has a 5-degree included angle it will not wedge, but will always work freely and smoothly with just the proper amount of friction.

The fixture may be used for grinding wheels having either concave or convex faces by moving the diamond point either side of the center of the stud. The diamond point is moved



Device for truing Radius Grinding Wheels

back for truing a wheel having a convex face, and forward for a wheel having a concave face. To set the diamond to a given radius, the dust-cap *A* is removed and the gage-bar *B* inserted in the hole in stud *C*. A size block of the dimension of the given radius plus 3/4 inch is used in the case of a convex wheel face, and a block 3/4 inch in length minus the given radius for a concave wheel face. The proper size block is placed on bar *B* as indicated. It will be noted that gage-bar *B* is made with the face of the stop 3/4 inch from the center of the stud hole.

In setting the device for a convex wheel face, screw *D* is tightened, thus binding the diamond-carrying rod in place. For a concave face, screw *D* is first tightened, after which collar *E* is held against the diamond rod holder *F* and fastened. Screw *D* is then loosened and the rod *G*, with the collar in place is drawn back to permit the removal of the gage-bar *B*. Dust-cap *A* is then replaced in the stud *C* and the diamond-carrying rod slid in to its original position with the collar against the holder *F*. Screw *D* is again tightened and the dresser is ready for service. It will be noted that the base of the device is designed for use on a grinder equipped with a magnetic chuck, but a base may be made to adapt it to any grinder using thin disk wheels.

* * *

A comparative summary of manufacturing conditions in the United States for the years 1919 and 1914, shows that there were 288,376 establishments in operation in 1919, as against 275,791 in 1914. The value of the products of these companies is placed at $61,588,905,000 in 1919 as against $24,246,435,000 in 1914. The value of automobiles increased from $503,230,000 in 1914 to $2,387,833,000 in 1919; cotton goods from $676,569,000 in 1914 to $1,877,919,000 in 1919; foundry and machine shop products from $866,545,000 in 1914 to $2,321,129,000 in 1919; iron and steel rolling mills from $918,665,000 in 1914 to $2,818,775,000 in 1919; woolen goods from $379,584,000 in 1914 to $1,053,875,000 in 1919.

Automobile Crankshaft Repair Work

Last of a Series of Three Articles on Automobile Repair Work

THE regrinding of crankshaft bearings is one of the most common jobs in crankshaft repair work. In the repair shop of Saucke Bros., Rochester, N. Y., the No. 4 Landis machine illustrated in Fig. 1 is employed for this kind of work. The illustration shows the regrinding of a Continental motor four-throw crankshaft, taken from a Republic truck. This machine carries two offset heads as a part of its regular equipment, which are provided with a graduated nut for roughly setting the chucks which the heads carry to agree with the throw of the crankshaft to be ground; a micrometer adjustment is used for obtaining the final settings. It will be noticed that the heads are counterweighted and also that the crankpin bearings being ground are supported by steadyrests from the front and bottom. The steadyrests carry maple bearings in contact with the surfaces to be ground so that there is no possibility of abrasion due to the revolving crankshaft.

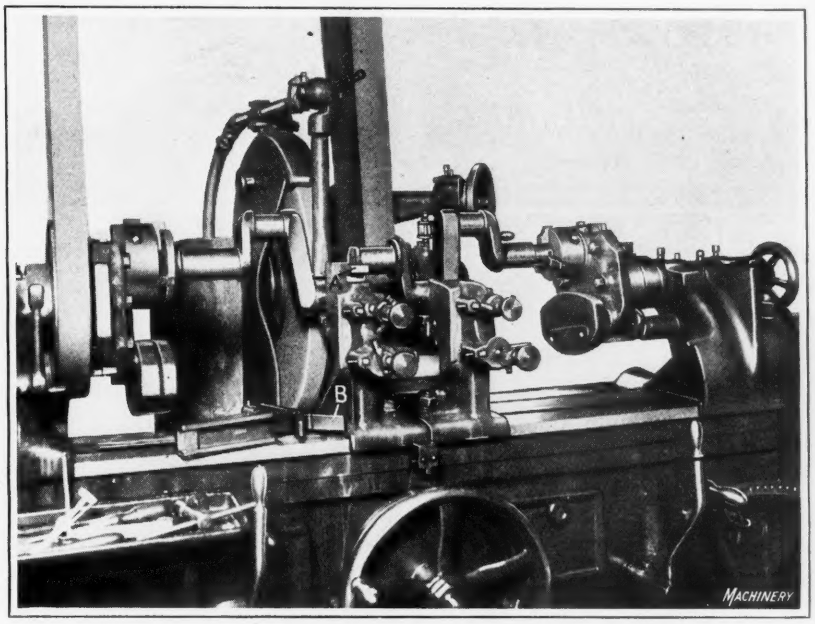


Fig. 1. Crankshaft Regrinding Machine set up for refinishing Crankpin Bearings on a Four-throw Crankshaft

The crankshaft is placed in the chucks of the offset heads after the chucks have been approximately adjusted to suit the throw of the crankshaft, but the chucks are not tightened on the end bearings until the throws are aligned with the centers of the machine. For obtaining this alignment a centering gage which is part of the regular equipment furnished with this type of machine is employed. This gage is shown lying on the ways of the machine to the left of the steadyrest bracket, and is used in the following manner. The gage is made to slide on the top guide *A* of the foremost steadyrest bracket, and when in this position a post carrying a V-block *B* at its lower end is permitted to drop down and engage the bearing of the crankshaft that is to be ground. Then by the use of a feeler 0.001 inch thick the amount of adjustment required to obtain perfect alignment is determined. When the centers of the throws are in alignment with the machine spindles, the chuck jaws are tightened and the wooden steadyrest bearings brought into contact with the crankpin bearing.

In this particular case the throw is 5¼ inches, and it was found that the greatest depth of score was 0.012 inch. In machining the rough surfaces of the bearing, 0.019 inch more stock was removed than was required to clean them up; in other words, 0.031 inch of metal was removed.

It is good practice on crankshaft work first to test the alignment on a lathe, using an indicator, and then if necessary straighten on an arbor press. The shaft should be within 0.007 inch of alignment before grinding. The crankpin bearings must not only be ground to uniform diameter, but they also must not vary more than 0.0025 inch between ends, that is, they must not be tapered. If this condition is found to exist it can be readily remedied by simply turning the entire table to compensate for any slight taper. The table pivots on a central pin, and the proper adjustment can be obtained by means of a graduated scale at the foot end of the machine. The wheel used in this shop for crankshaft regrinding is a 24-inch wheel of proper face width to agree with the length of bearings being ground. This wheel is the regular Landis 246 shape, grade K, and is made by the Abrasive Co., Philadelphia, Pa. The time required for the job illustrated is as follows: Setting up, about 1½ hours; grinding the four crankpin bearings, about 2¼ hours; and grinding the three main bearings, about 1¾ hours.

It is sometimes necessary to repair the end bearing of a crankshaft which has been broken or twisted off, and Fig. 2 shows a job of this kind being performed in the Frostholm Bros. plant at Syracuse, N. Y.

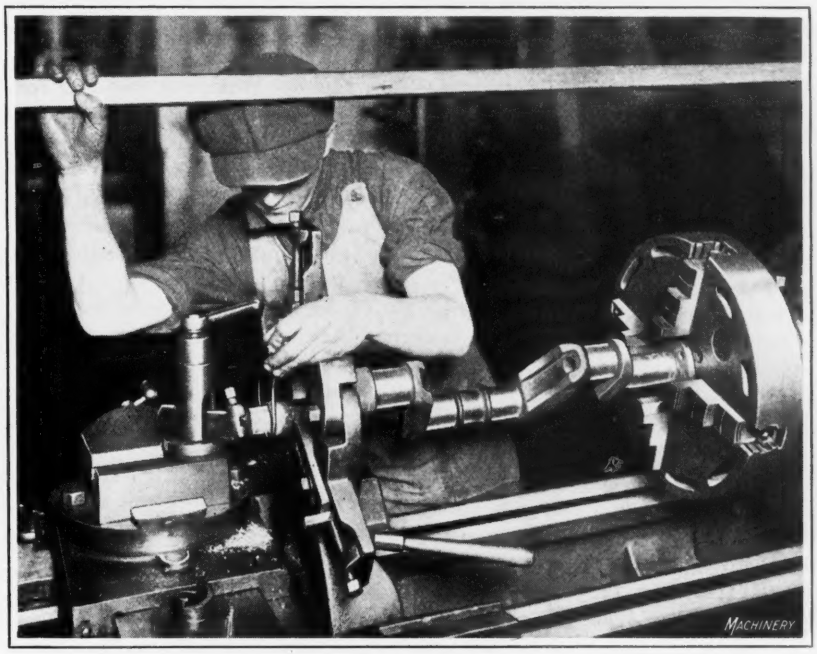


Fig. 2. Repairing the Twisted-off End of a Crankshaft

The machine used is a Whitcomb-Blaisdell engine lathe in which the shaft is chucked by the flywheel flange and supported at the overhanging end by a steadyrest. This is a Duesenberg motor four-throw crankshaft, which has previously been built up on the end by acetylene gas welding. The work illustrated is simply that of turning the welded end to the proper diameter.

* * *

METHOD OF FILING REFERENCE PRINTS

By T. H. MORIARTY

In a certain plant the practice of using tracings for reference resulted in many valuable tracings being damaged. In order to overcome this trouble Van Dyke or brown prints of all tracings in common use for reference were made up and folded twice. Each print was placed in a commercial mailing envelope, 13 by 19 inches in size, and the number of the print was blue-penciled in large figures near the top center of each envelope. The envelopes were then filed numerically in a wooden box, which was made for the purpose.

A draftsman, instead of referring to the tracing, would then use the print. Before removing the print, he would write his name on the envelope, and on the return of the print the name would be crossed off. This method is so simple that no filing clerk is necessary, and little difficulty is experienced through draftsmen forgetting to sign their names when removing prints from the file. When the tracings are revised, new prints are automatically supplied to replace the old ones. This system has been in use for over a year and has resulted in a great saving, as no original tracings are worn out through excessive handling. A saving in time is also effected, as there is no waiting for tracings to be returned from the blueprint room.

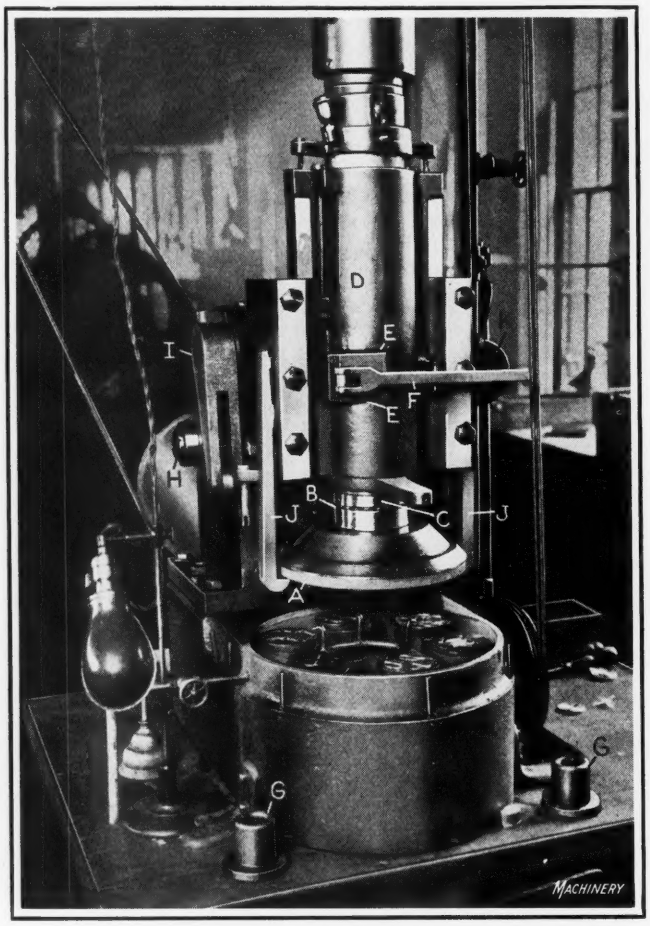
* * *

EXPORTS OF MACHINERY DURING 1921

The Industrial Machinery Division of the Department of Commerce, in a special review of the machinery export situation, points out that during the first eleven months of 1921 the United States exported machinery of all kinds to a value of $238,000,000 as against $92,300,000 for the entire year of 1913. While official figures for the entire calendar year of 1921 are not yet available, it is believed that $250,000,000 is a conservative estimate of the total value for the year. The foreign trade in metal-working machinery for the year ended June 30, 1913 was $16,097,315, and for the year ended June 30, 1914, $14,011,359. For the first eleven months of 1921 the total exports of metal-working machinery amounted to $18,766,962 of which $8,468,440 represented machine tools. In comparing the exports for 1921 with the pre-war exports, it should be remembered that the prices in 1921 were nearly double the prices in 1914, so that the relative volume is not in direct proportion to the figures given.

WATCH PLATE STONING MACHINE

A rotary grinding or stoning machine used to finish the surfaces of watch plates in the plant of the Waltham Watch Co., Waltham, Mass., is shown in the accompanying illustration. This machine was developed by A. G. Cassidy, master mechanic of the Waltham Watch Co. The stoning operation is performed with a ring lap *A*, and this lap is carried on a spindle which has a shoulder at *B*, the top surface of which forms the lower raceway for a ball bearing. The upper raceway of the bearing is the lower end of a sleeve *C* through which the main part of the shaft extends. This shaft projects up beyond the beams to which the countershaft is hung, and at the upper end is connected by a clutch to the bevel gear shaft from which it is driven.



Watch Plate Stoning Machine

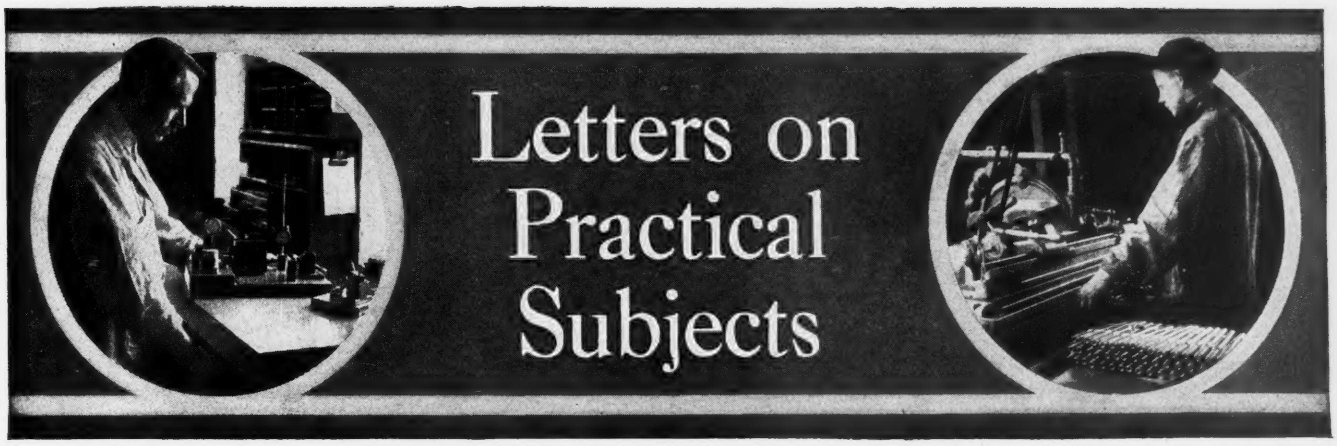
The vertical feed of the spindle is actuated by air pressure, the air cylinder being located above the countershaft beam. The sleeve through which the spindle operates is contained in the cast-iron bearing *D*. This bearing has an opening at *E* through which a clamping lever *F* passes, by means of which the vertical position of the sleeve and the shaft which carries the lap can be adjusted following each operation to compensate for wear on the face of the lap.

The chucks, of which there are six, rotate slowly during the grinding operation. The machine is operated by air, as previously stated, it being necessary to use both hands on the valves *G* when starting the machine, thus safeguarding against danger to the operator's hand. As soon as the air valve governing the feed movement has operated, shaft *H* which carries the feed-cam is revolved and the arm *I* feeds the entire spindle-bearing unit downward; after the work has been ground to the desired thickness, the lap and the spindle are raised. When the unit has reached its uppermost position and the air valve which controls the feed movement has been closed, the plunger in air cylinder *K* releases lever *F* and allows the sleeve to slip downward and be relocated by the fingers *J* which hang on opposite sides of the spindle slide. These fingers are operated by an air plunger at the top end immediately preceding the release of the spindle sleeve.

As soon as this vertical adjustment has been made, the plunger in air cylinder *K* again advances and holds the sleeve firmly in its new position in bearing *D*; then fingers *J* swing out from under the lap. The release of the clamping section of bearing *D* is by springs interposed in back of the section between the opening for the clamping lever. The various movements just described are all governed by cam-operated air valves in the base of the machine.

* * *

A bulletin on the manufacture, properties, and uses of aluminum alloys is being prepared for publication by the Pittsburg Experiment Station of the United States Bureau of Mines.



COLD RIVETS FOR ELECTRICAL APPARATUS

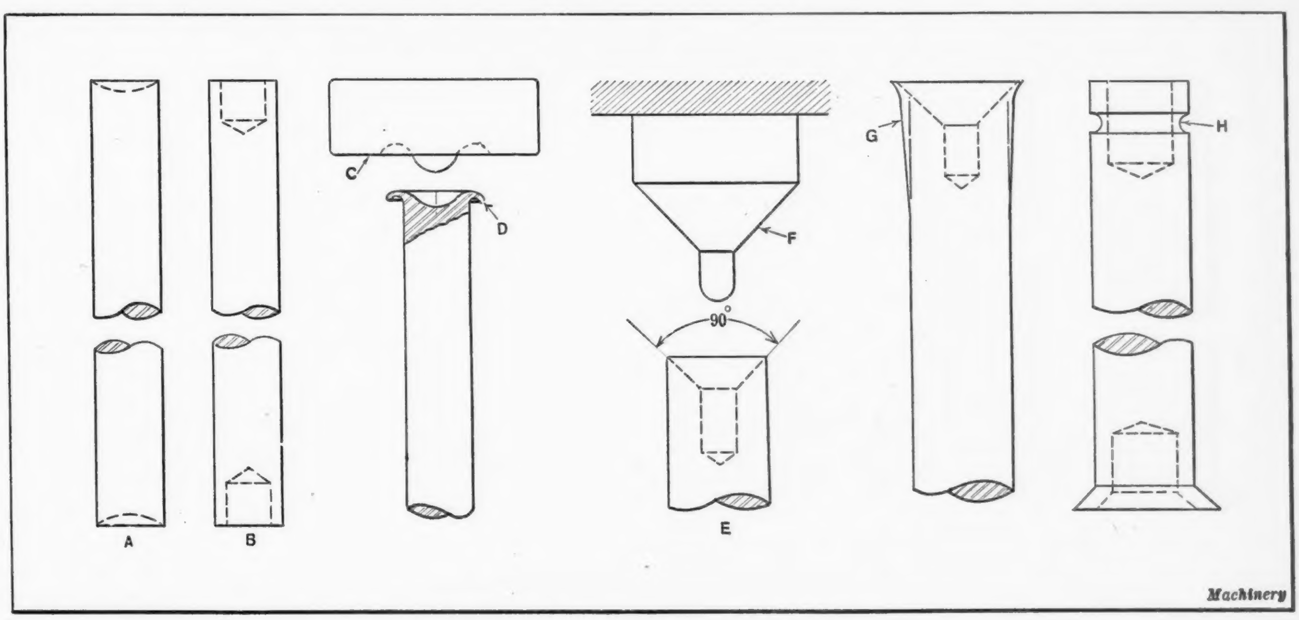
The type of cold rivet usually employed in the manufacture of laminated iron pole-pieces for electrical apparatus is shown at *A* in the accompanying illustration. These rivets are made slightly concave at each end so that they may be readily headed by a pneumatic hammer. Five or six rivets are needed, as a rule, for each pole-piece, and from 100 to 200 blows of the pneumatic hammer are required to head each rivet properly, the number of blows depending on the size of the rivet. This is a very slow process, and the cost of replacing worn and broken parts of the pneumatic hammer is considerable. At *B* is shown a rivet with a drilled hole at each end. The holes are drilled about ¼ inch deep and of such diameter as to leave a wall from 1/16 to 5/32 inch thick, depending on the size of the rivet. Rivets of this design can readily be upset on both ends at one operation in a hydraulic press by equipping the upper and lower dies with hardened steel buttons like that shown at *C*. The shape of the head after compressing is shown at *D*.

A ½-inch rivet, such as shown at *B*, having a wall thickness of 5/64 inch requires an upsetting pressure of three tons. Using five rivets to a unit, the pressure required for the upsetting operation would be fifteen tons. Allowing a pressure of six tons for compressing the laminations, the total pressure for the whole operation would be only twenty-one tons. It will be evident that this method of assembling will effect a considerable saving.

Cold rivets for other purposes are often machined as shown at *E*. The upsetting of these rivets is also accomplished by means of hydraulic pressure. This type of rivet is used in nearly all small motors having laminated iron fields and malleable iron frames. A ¾-inch rivet of this design requires a 27-ton pressure for upsetting at its ends. This high pressure is necessary because of the 90-degree taper *F* on the punches. As the pressure is applied these rivets have a tendency to expand in the field frame before the heads are formed. This incorrect design of rivet as shown expanded at *G* prevents the two frames from closing in tightly on the laminations. It also causes a great loss in hydraulic power. With this process a pressure of about 250 tons is required to compress one unit of four rivets.

Using the method illustrated at *D* and calculating the pressure required to head the four rivets as $4 \times 27 = 108$ tons, allowing an additional pressure of 12 tons for compressing the field laminations, the total pressure would be 120 tons. The process illustrated at *D* is therefore shown to be more economical, as it requires 130 tons less pressure than when using rivets like that shown at *E*. A ¾-inch rivet like the one shown in the diagram at *B* could be upset with a pressure of 9 tons. Four rivets would consequently require a pressure of 36 tons. By allowing an additional pressure of 12 tons for compressing the field laminations, a total pressure of 48 to 50 tons would be required instead of 130 tons. Rivets of the type shown at *H*, with grooves cut at the bending points, are preferable for castings with frail frames, although not absolutely necessary. The grooves prevent the rivet from expanding below the head as is the case with the rivet shown at *G*. It will be seen from the foregoing that it is often possible to employ a lighter weight casting by selecting the type of rivet best adapted for the work at hand, and at the same time to effect a reduction in the cost of manufacture and in the expense for tool equipment.

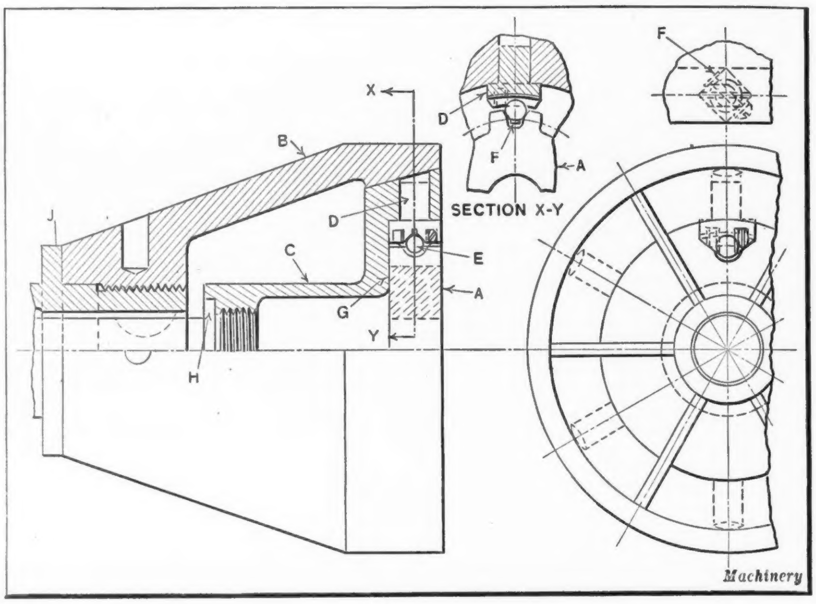
East Orange, N. J. JOHN E. UNGER



Various Designs of Cold Rivets used for Electrical Apparatus

CHUCK FOR SPIRAL GEARS

The special chuck illustrated is designed for locating and holding a spiral gear that is required to have the shaft hole ground concentric with the pitch circle. The spiral gear (a section of which is shown at *A*) has a pitch diameter of approximately 4 inches, a 45-degree left-hand spiral, and teeth of 6 diametral pitch. The chuck may be referred to as a "ball-control" type, because steel balls, brought into contact with the teeth at points near the pitch circle, serve to locate the gear and hold it tightly in place. As this chuck has proved capable of accurate work, and can be adapted to nearly all internal grinding machines, it may be of interest to those who have work of a similar nature. The chuck consists essentially of a heavy cast-iron body *B*, which is screwed on the spindle of the machine, and a spring collet *C*, which is split to suit the number of teeth in the gear. The collet carries the ball-holders *D*, which are located between the slots in such a position that the balls *E* come in contact with the gear teeth as indicated.



Chuck designed for locating and holding Spiral Gears

The ball-holders are made of square stock and have round shanks machined at one end as shown. These holders also have a V-slot cut across the corners in their squared heads, which serves to locate the balls and transmits the required inward clamping movement when the chuck is tightened. The balls are held in holders *D* by small steel straps *F* in such a manner that they are permitted to roll a limited distance in the V-slots in holders *D*.

A rolling or rotary motion is imparted to the gear when inserting it in the chuck. The gear is held against face *G* by the grinding wheel spindle until the collet is drawn up by means of the draw-bar *H*, which is actuated by a handwheel at the end of the machine spindle *J*.

Pittsburg, Pa. WILLIAM OWEN

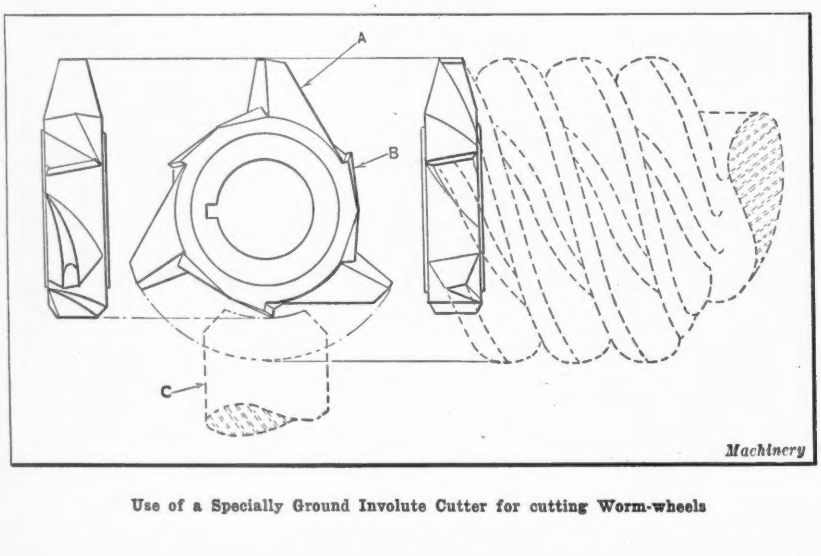
CUTTING WORM-WHEELS WITH A SPECIAL INVOLUTE CUTTER

It is customary, in shop practice, to use a fly cutter in cutting sample worm-wheels. In using this method to cut worm-wheels having multiple threads, considerable care is required to insure accuracy in the lead and pitch of the threads. In the accompanying diagram is illustrated a unique method which was used successfully in cutting a triple-thread worm-gear. Instead of the usual fly cutter, a regular No. 1 four-pitch involute gear-cutter was used, being ground in such a manner as to leave six teeth, three of which were ground like the one shown at *A* to fit a No. 1 worm pitch gage, and the remaining three, as shown at *B*, like a milling cutter used for milling flat work.

A 3-inch diameter, 1-pitch, left-hand triple-thread worm, with a lead of 3 inches is shown in dotted lines at the side of the milling cutter to make clear the action of the cutter. The three teeth *A* are equally spaced, and there is one tooth for each of the triple threads. As one tooth of the cutter takes a cut and leaves the tooth space of the worm-wheel, the next cutter tooth enters the succeeding tooth space of the worm-wheel being cut. The three teeth which are ground down as shown at *B* are for the purpose of cutting the proper clearance radius at the top of the worm-gear teeth. A section of the worm-wheel which is to be cut is shown by the dotted lines at *C*. The three equally spaced teeth *A* are ground circularly to the same diameter as the worm to be used with the worm-wheel, plus an amount equal to 0.1 times the linear pitch of the worm, in order to provide the necessary clearance. A regular cutter grinder was employed to grind the sides of the teeth *A* to fit the 29-degree worm thread gage. Care was taken to obtain the correct lead and the proper helical and radial angles, and to insure the correct clearance for a 1-inch pitch, 3-inch lead hobbing cutter, as well as to grind the three teeth *B* to the proper size for cutting the worm-gearing to the correct throat depth. It required a little less than ten hours to grind the cutter.

The cutter was mounted on the spindle of a regular hobbing machine, care being taken to have the center of the cutter teeth on a radial line passing through the center of the worm-gear. As the cutter had a tooth for each thread, it was unnecessary to reset the cutter for each lead. The worm-wheels had thirty-three teeth in this case and as three tool settings would have been required had a fly cutter been employed, it can be clearly seen that it would have been difficult to obtain great accuracy with the fly cutter method. It was found that the same feeds as used with a regular hob could be employed when using the reground involute cutter.

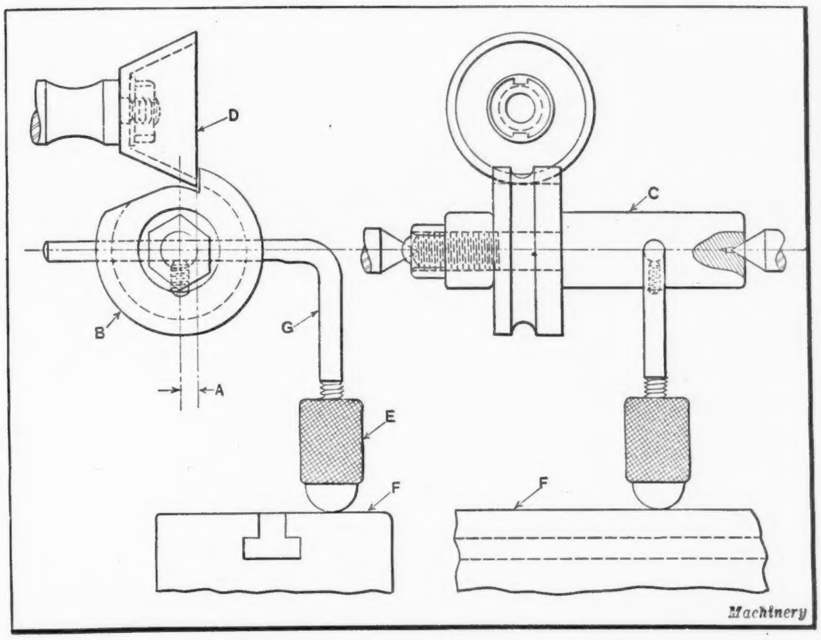
Cleveland, Ohio J. E. BAKER



Use of a Specially Ground Involute Cutter for cutting Worm-wheels

MANDREL FOR GRINDING CIRCULAR FORMING TOOLS

The mandrel shown at *C* in the accompanying illustration is intended primarily for holding circular forming and cutting-off tools while grinding their cutting edges on a toolroom grinder. Ordinarily the cutting edge or



Use of Mandrel for holding Circular Forming Tools while grinding

face of a circular forming tool is milled back from the center line of the cutter a predetermined distance *A*, in order to obtain a better cutting action. A circular cutter of the type shown at *B* is held on the mandrel by means of a collar and hexagonal nut. When performing the grinding operation, mandrel *C* is held between the centers of the grinding machine.

The grinding machine saddle is adjusted until the face of the grinding wheel *D* extends beyond the vertical center line of arbor *C*, the required distance *A*. The knurled adjusting nut *E* is then allowed to come in contact with the top surface *F* of the machine table. Nut *E* is tapped to fit on the threaded end of the bent rod *G* and prevent it from working loose after adjustment. The forming cutter can be revolved toward the working face of the grinding wheel after each cut, by adjusting knurled nut *E*. This method of feeding the work to the grinding wheel serves to keep the distance *A* practically constant. Very slight variations due to the wearing down of the grinding wheel face, however, may occur, but these can easily be compensated for by resetting the grinding wheel.

Conneaut, Ohio F. A. Gross

ASSIGNING DRAWING NUMBERS

In a certain drafting-room each new drawing was assigned a new number in rotation, and as there were a large variety of machines and tools, it was finally decided to make the numbers of all drawings for each job run consecutively. Accordingly it became the practice for each draftsman working on a separate design, to reserve a group of numbers for that particular job, marking the reservation in pencil upon the record book, and being sure to reserve enough numbers to more than cover the number of drawings needed.

This practice led to confusion in some cases, as there was sometimes a blank space of numbers left that were never used, and there was also a tendency to use the same number twice, if anyone failed to mark down a number taken for a small job. To avoid this confusion, it was decided to let the filing clerk keep the drawing record, and make him responsible for the assignment of all drawing numbers. At the same time each draftsman was to be allowed to take as large a group of numbers as he believed would be required for his job.

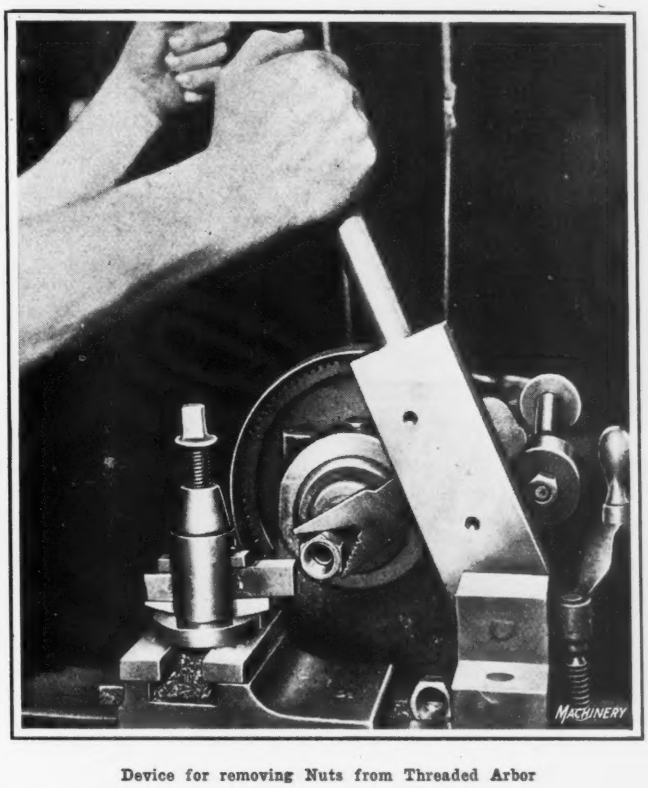
The clerk, instead of directly marking down the name of every drawing for which he assigned a number, took a bunch of old cards from which he made tickets, keeping a hundred or more in reserve. On each of these tickets he marked one of the numbers that followed in rotation, and then looking back over the record, found all the blank numbers that had not been assigned, and made tickets to correspond with them. Whenever a draftsman desired to reserve a group of numbers, he would receive as many tickets as there were numbers wanted, always seeing that the numbers handed out for one job were in consecutive order. The draftsman receiving these numbers would hold the tickets until the job was complete, marking down the title and subtitle of each drawing, with such other information as was to be recorded, on the ticket. When the work was finished, and no more drawings were to be made for that job, the whole group of tickets was returned to the clerk, who entered them on the permanent record, leaving all the blank numbers so returned, to be reissued at the first opportunity.

If a small job came in, the smallest group of consecutive numbers that could be used was issued, and if a very large job was begun, the group was issued from entirely new numbers. The tickets were so kept that it was easy to find a group of numbers that would just about suit the size of the job to be provided for. This was done by keeping the tickets in a box with spacing cards between the groups.

North Judson, Ind. William H. Kellogg

FACING NUTS SQUARE WITH THREAD

It is not always a simple matter to devise a satisfactory and economical method of facing nuts so that their finished faces will be square with the threads, or in other words, so that the face of each nut will be at right angles to the axis of its thread. If a plain threaded arbor is inserted in the lathe spindle and the nut screwed on this arbor and tightened up against a shoulder while being faced, the work will vary considerably in accuracy. If the back face of the nut is at right angles to the thread, the front face will usually be finished true; but if the back face is not square with the thread, the front face will also be out of square when finished. In order to eliminate this trouble and obtain



Device for removing Nuts from Threaded Arbor

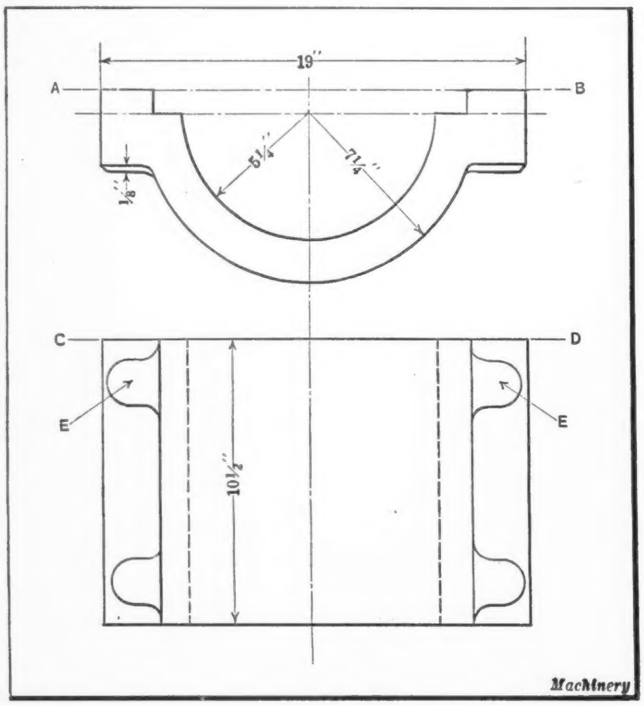
more accurate results, an arbor was made with the threads at the low limit pitch diameter for a length equal to three-fourths of the thickness of the nut, and from this point tapered 0.020 inch per inch for a distance of from four to six threads. The nut can be assembled on this arbor while the machine is in motion. When it reaehes the tapered part of the thread on the arbor it locks tight enough to permit a light cut to be taken on the face. The nuts faced while held on this arbor were found to be true within 0.002 inch, when tested with an indicator. However, it was a difficult matter to remove the finished nut from this arbor by means of a hand wrench.

The accompanying illustration shows clearly the method adopted for removing the nuts, which enables the work to be done rapidly and without danger to the operator. With this device the operator reverses the machine with one hand while he operates the nut remover with the other. It will be seen that the device consists simply of an elongated wrench attached to a lever in such a manner that it can be quickly brought forward to grip the work.

Clio, Mich. CHARLES E. HENDRICKS

MOLDING A LARGE BEARING CAP

The breaking of a cast-iron bearing cap of the dimensions shown necessitated supplying a new casting at once. Accordingly, a pattern was made and sent to the foundry with an order to deliver two castings as soon as possible. The molder knew that it would take time to provide sand bars or gaggers that would properly support the body of hanging sand in the cope flask if the mold was made in the customary manner with *AB* as the parting line between the cope and the drag. Consequently, he removed the four



Bearing Cap molded in Upright Position

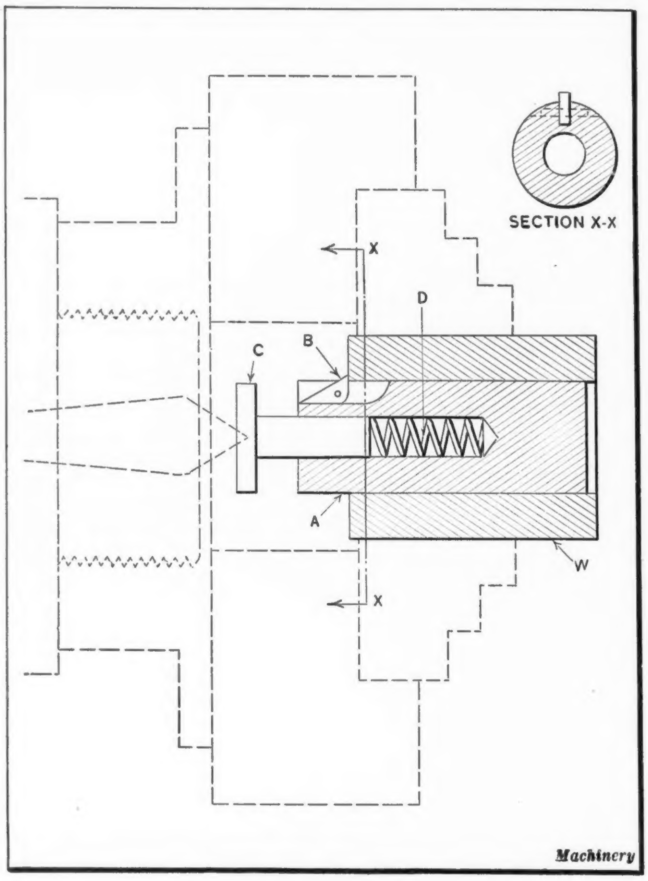
bosses *E* from the pattern, leaving it plain and straight so that it could be molded on end in a plain drag and flat cope, with the cope parting on line *CD*.

Kenosha, Wis. M. E. DUGGAN

LENGTH GAGE

The machining of the work or bushing shown at *W* in the accompanying illustration was greatly facilitated by the use of the special gage shown. The work was to be left rough on the outside, but was required to be bored, reamed, and faced on both ends at one chucking. The final facing operation was required to finish the work to a predetermined length. A 14-inch three-jaw chuck, indicated by dotted lines, was employed to hold the work, which was about 4 inches long and 3 inches in diameter.

The gage consists of a cylindrical member *A*, which is made a good sliding fit for the reamed hole in the work; a triangular shaped stop *B* pivoted in a slot cut in part *A*; a plunger *C*; and a compression spring *D*. In chucking the work, care is taken to see that the inner end projects beyond



Gage employed in facing Bushing to Length

the inner surfaces of the chuck jaws a sufficient distance to permit the use of a back-facing tool.

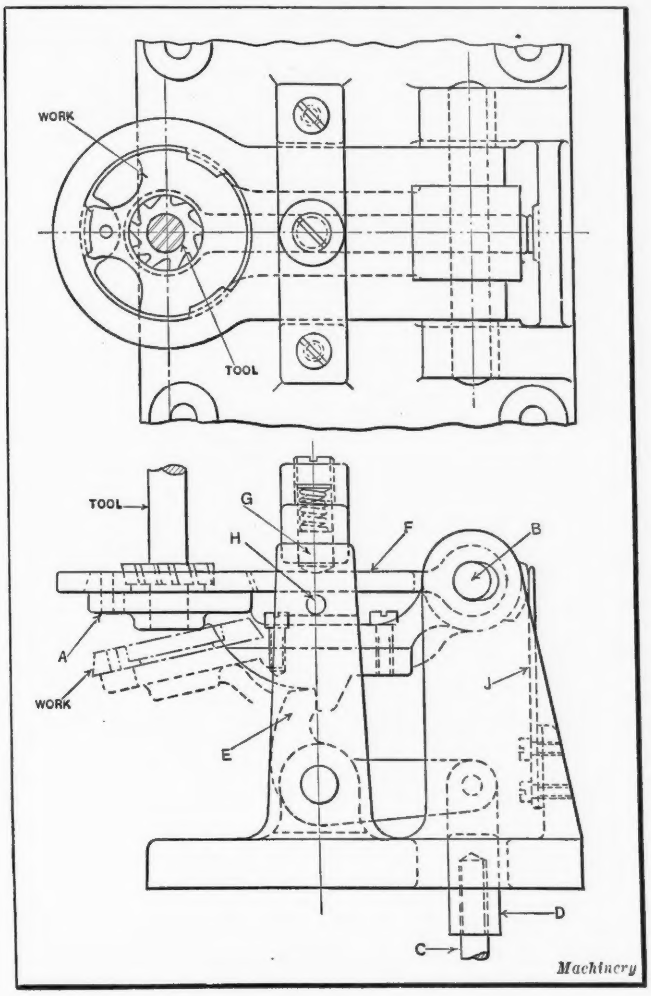
After boring and reaming the work to the required size, the inner end is faced off with the back-facing tool. The gage is then slipped into the reamed hole and pressed inward against the action of spring *D* until the pivoted triangular stop *B* passes the faced end of the work and assumes the position shown in the illustration. It is evident that the stop, when in this position, will prevent any outward movement of the gage, and that spring *D* will hold it in place while the outer end of the work is being faced. The distance from the perpendicular face of stop *B* to the outer end of part *A* corresponds to the length of the finished work. Therefore, a facing tool can be easily set for the final finishing cut by bringing it up until it just makes contact with the end of part *A*.

Rosemount, Montreal, Canada HARRY MOORE

PEDAL-OPERATED DRILL JIG

A drill jig or fixture which permits a high rate of production, and which may be adapted for drilling, tapping, and counterboring, is shown in the accompanying illustration. The locating nest or plug *A* is dropped to the position shown by the dotted lines to facilitate loading and unloading. Part *A* pivots on the pin *B*, and is operated by a foot-pedal through the connecting-rod *C*, yoke *D*, and operating cam *E* which is shown in the raised position. The cam *E* is released by a spring under the bench, allowing the locating nest to drop when pressure is removed from the foot-pedal.

The work is clamped by the upper plate *F* which is acted upon by spring plunger *G*. A stop-pin *H* limits the upward travel of part *A*. The flat spring *J* absorbs the slight shock resulting from returning the work-table to the operating position, and thus prevents undue wear of the elongated pivot hole. This type of drilling fixture can be designed with interchangeable locating nests and bushing plates, and when so equipped will be found convenient for a large variety of drilling machine work. A special counterboring tool is shown in the operating position in the illustration.



Drill Jig operated by Foot-pedal

Waynesboro, Pa. D. A. Nevin

JIG FOR DRILLING COMPANION FLANGES

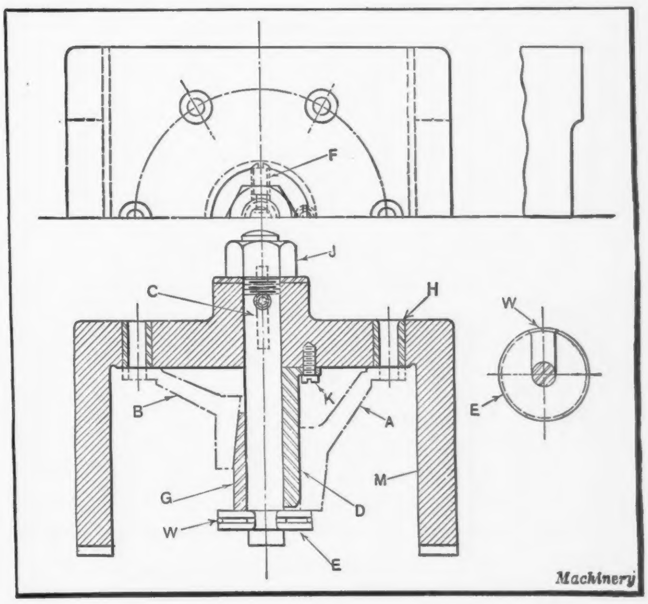
The jig shown herewith was designed for use in drilling six holes in each of two companion flanges. A half section of one flange is shown by heavy dot-and-dash lines at *A*, and a half section of the other at *B*. The two finished flanges are bolted together when in use. The holes in each flange must therefore be spaced the same and be of the same size. Being so nearly alike, it was found advisable to design a drill jig that could be used for both pieces. The jig body was made of a channel-shaped casting *M* in the top of which were pressed six drill bushings like that shown at *H*. The under side of the top section is finished to provide a locating pad for the flanged face of the work. In the center of the top is a boss of sufficient length to give the required bearing surface for the draw-bolt *C*, which is a sliding fit in the casting. The bottom of the jig body is finished and relieved, as illustrated, to give a four-point bearing on the drilling machine table.

Let us consider first the drilling of flange *A*. The hub of this flange has a straight reamed hole in it. The plug *D* is therefore used when drilling this piece. Plug *D* is a sliding fit on draw-bolt *C*, and the outside diameter is a slip fit in flange *A*. After loosening the nut *J* on the top of the draw-bolt, the work is placed on the plug and washer *E* slipped into place in the groove on the draw-bolt. The bolt is then drawn up by tightening the nut *J*, thus pulling the slip washer against the hub end and clamping the face of the flange firmly against the finished under side of the casting.

In draw-bolt *C* there is a slot into which enters the pivot end of set-screw *F*. This set-screw is a sliding fit in the slot and keeps the bolt from turning when the nut is tightened. As it requires but a fraction of a turn to release the bolt enough to permit the slip washer to be easily withdrawn, the slot need not be very long to allow the required adjustment. A small fillister-head screw *K* passing through the flange of plug *D* and screwed into the casting keeps the plug from turning while the work is being put in place, and also keeps the plug from being pulled off the draw-bolt when the work is withdrawn from the jig.

Flange *B* has a tapered hole in the hub. To adapt the jig to this piece, a tapered plug *G* having a slip fit over the draw-bolt and tapered on the outside to fit the hole in the hub of the flange is used. The length of this plug is such that when it is drawn into the hub, its lower end will be approximately the same distance from the locating surface of the casting as the end of the hub of flange *A*. In this case the slip washer is pulled up against the plug itself, which is drawn into the tapered hole when the nut *J* is tightened, thus centering the flange and drawing the face firmly against the locating surface.

As there was no six-spindle drill head available when this jig was first used, the drilling of each flange was done with a three-spindle drill head, which necessitated two operations. The three drills in the head were equally spaced and of the same length, so that they entered the work at the same time, thus bringing all the thrust on the draw-bolt nut. The plugs and the draw-bolt are of hardened steel. To avoid confusion, each plug is stamped to show the work for which it is intended. When the jig is withdrawn from the tool-crib, the plug required for one piece only is given out. The other plug is left in the crib in the space provided for the jig itself.



Jig for drilling Companion Flanges

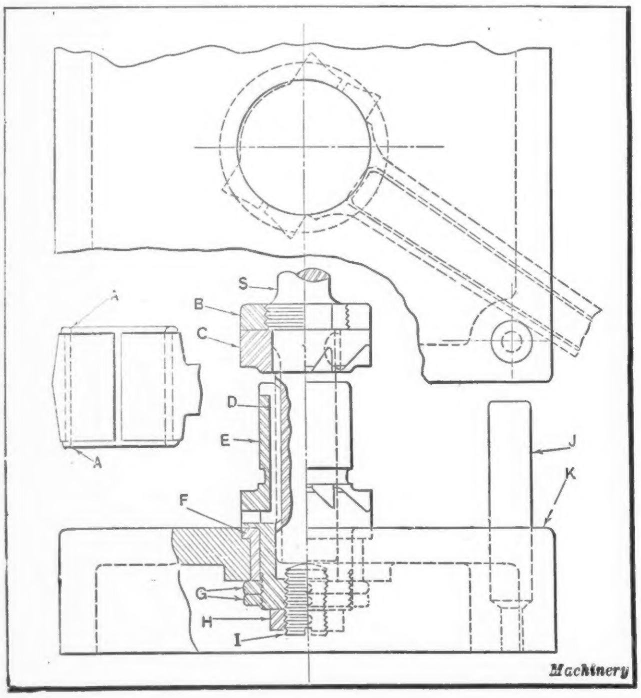
To prevent loose parts from becoming lost while the jig is in the tool-crib, the plug *D* is left attached to the jig, but swung aside, using the screw *K* as a pivot so that plug *G* can be placed on the draw-bolt. Slip washer *E* has a groove turned on the outside into which is snapped a spring wire ring *W*. When the jig is in use, the wire is slid around until the opening between the ends is on the same center line as the opening in the washer, as shown in the assembly

view. When the jig is in the tool-crib, this wire is slid around after the plug G is put in place so as to close up the opening in the washer as shown in the detail at the right. When the plugs G and D and the slip washer are put in place as described, there is little possibility of any parts becoming lost, as they are all assembled in one unit.

Pittsburg, Pa. CLARENCE M. SCHLEH

TOOL FOR FACING CONNECTING-ROD BUSHINGS

The facing tool shown herewith is used to finish-face both sides of a connecting-rod bushing and round the ends to the radii indicated at A. Referring to the illustration, S is a hardened and ground tool-steel member provided with a tapered shank. A right-hand, formed facing cutter C is pressed on part S and keyed to it with a Woodruff key as shown. The threaded collar B allows the cutter C to be removed in case of breakage, or for regrinding. The lower



Facing Tool for Connecting-rod Bushings

end of part S, which has a keyway cut in it, acts as a pilot for cutter C and as a driver for the lower left-hand cutter E. The upper part of cutter E is made a slip fit for the bore in the connecting-rod bearing.

A key D, pressed into a keyway in cutter E is made a slip fit in the keyway cut in S. The lower cutter E revolves in bushing F and is held in place by the lock-collars G. The adjustable stop I, locked by nut H, is set according to the width of the connecting-rod bearing. In operation, the tool body S with cutter C is withdrawn from the lower cutter E and the connecting-rod is placed in position on E. The tool body S is then lowered, and its pilot introduced for a short distance into E. The machine is next started and the upper cutter C is fed down until the bottom of the pilot on S strikes the stop I, thus completing the operation. A stop-plug J, pressed into the cast-iron base K, prevents the connecting-rod from revolving when the tool is in operation.

When both the cutters C and E are ground with the same clearance, they will remove the same amount of metal from the top and bottom of the bearing and will not chatter. As the bushings faced by this tool are of babbitt and brass, the cutters can be used a considerable time before requiring regrinding. This tool will hold the bearing width to within 0.0005 inch of the specified dimension.

Chicago, Ill. HAROLD A. PETERS

DETERMINING HEIGHT OF ARC WHEN MILLING KEYWAYS

Formulas for determining the height of arc A, Fig. 1, were given in December, 1920, MACHINERY on page 377, and in June 1921 on page 975. A formula similar to the ones given, but which the writer believes to be more convenient to apply is the following:

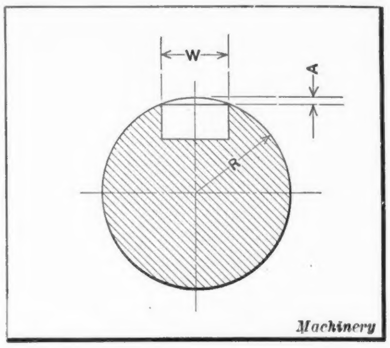


Fig. 1. Diagram used in finding Height of Arc

$$A = \frac{W}{2} \times \tan\frac{a}{2}$$

This formula is derived as follows: Referring to the accompanying illustrations,

$$\frac{\frac{1}{2}W}{R} = \frac{W}{2R} = \sin a;$$

$$b = 90 \text{ degrees} - \frac{a}{2}$$

$$\frac{A}{\frac{1}{2}W} = \cot b; \qquad A = \frac{W}{2}\cot\left(90 \text{ degrees} - \frac{a}{2}\right)$$

But as

$$\text{Cot}\left(90 \text{ degrees} - \frac{a}{2}\right) = \tan\frac{a}{2}, \text{ it follows that}$$

$$A = \frac{W}{2}\tan\frac{a}{2}$$

To use this formula, first find the sine of angle a by dividing the width of the keyway by the diameter of the shaft or hole. By consulting a table of trigonometric functions, the magnitude of this angle is found; then the tangent of one-half this angle is multiplied by one-half the width of the keyway. As an example let it be required to find A

when $W = \frac{7}{32}$ inch and $R = \frac{7}{16}$ inch.

According to the formula $A = \frac{7}{64}\tan\frac{a}{2}$

Then,

$$\text{Sin } a = \frac{W}{2R} = 0.25, \text{ and } a = 14 \text{ deg. } 29 \text{ min.}$$

Hence

$$\frac{a}{2} = 7 \text{ deg. } 14.5 \text{ min. and } \tan 7 \text{ deg. } 14.5 \text{ min.} = 0.12707$$

Therefore

$$A = 0.10938 \times 0.12707 = 0.01389$$

Hamilton, Mich. LEO LAUBMEYER

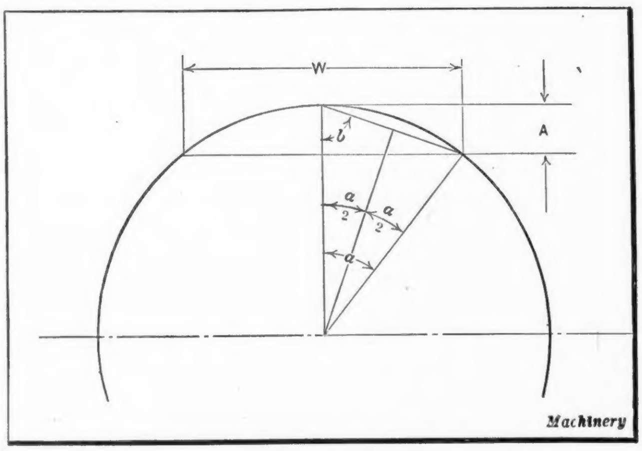
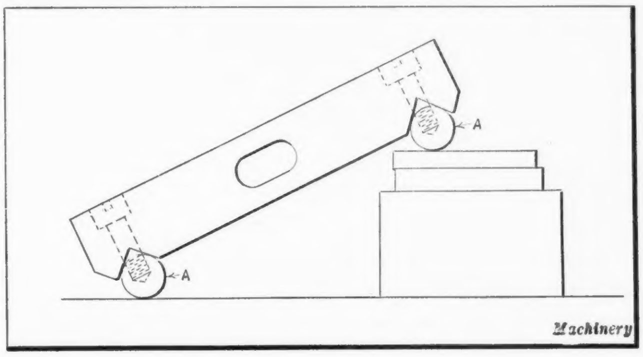


Fig. 2. Diagram used in deriving Formula for Height of Arc

SHOP AND DRAFTING-ROOM KINKS

CONVENIENT SINE BAR

The accompanying diagram illustrates a sine bar which may be accurately and quickly set up by the use of gage-blocks. Two plugs *A* are held in the vees of the sine bar



Convenient Sine Bar

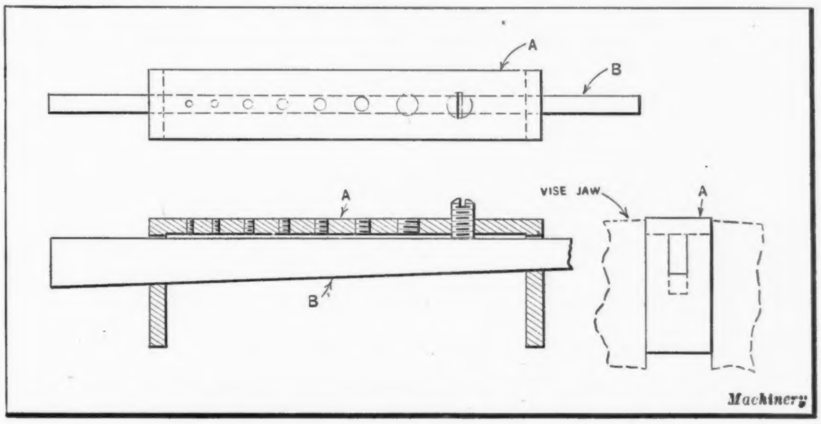
by means of fillister-head machine screws. These plugs project beyond one side of the sine bar a sufficient distance to permit the use of the latter in the same manner as one of the ordinary type. The construction is such that the sine bar can be readily made to the required accuracy, it being simply necessary to grind the vees after hardening in order to secure the desired distance between the two plugs.

Rosemount, Montreal, Canada — STANLEY ALMOND

HOLDER FOR SMALL SCREWS

Most mechanics find it difficult to hold small screws while slotting their heads, shortening them, rounding their heads, or performing any of the operations required to adapt them for various purposes. Holding them in the vise usually results in flattened threads and frequently the screw flies from between the vise jaws and is lost as soon as the file touches it.

A useful device for holding small screws can, however, be made as shown in the accompanying illustration. A device of this kind will well repay one for the time spent in making it. A piece of 1/8-inch steel is tapped for different sized screws along its center, and the ends bent down at right angles, forming the holder shown at *A*. Next a taper wedge *B* is made from the same stock. Two slots are then cut in holder *A* to accommodate this wedge. The piece *A* is held in the vise as indicated in the view at the lower right-hand corner of the illustration. A screw which is being operated upon is screwed into holder *A* until it projects on the under side. The wedge *B* is then lightly tapped into place, thus holding the screw securely.

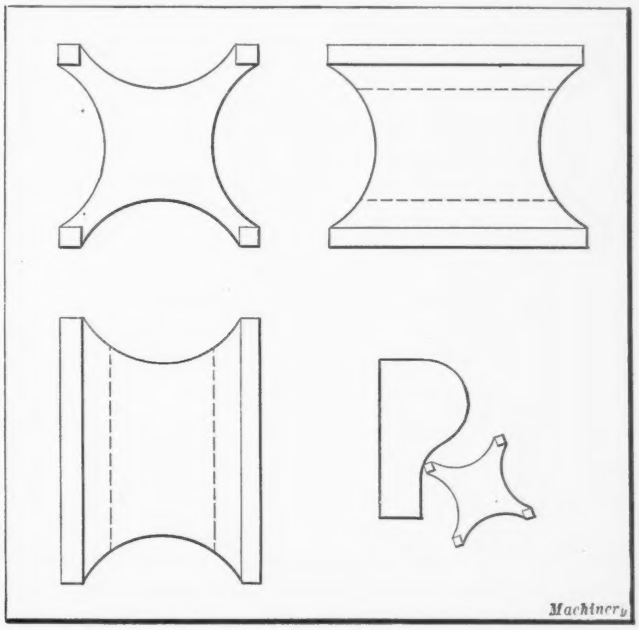


Convenient Device for holding Small Screws

Rosemount, Montreal, Canada — HARRY MOORE

TEMPLET SCRAPER

In making templet and profile gages, it is often difficult to produce the working surface of the templet or gage with assurance that it will be exactly perpendicular to its parallel flat sides. This difficulty is caused mainly by the fact that much hand work is required in perfecting the profile of the tool. A scraping tool which will greatly assist in working down the contour surface of a templet or profile gage is shown in the accompanying illustration. This tool should be made of tool steel, and hardened and ground on all its working surfaces. It is used in the manner indicated in the lower right-hand corner of the illustration. The templet is laid on a surface plate, and the scraper, which will



Scraper for finishing Edges of Profile Gages and Templets, and Method of Use

always rest so as to bring the working edges absolutely perpendicular to the surface plate, used to scrape down all slight imperfections until the desired profile is obtained.

Ilion, N. Y. — D. R. GALLAGHER

CUTTING KEYWAYS IN A BORING MILL

In the shop where the writer was employed, a 22-inch blower fan hub was to be rebored and resplined, and as there was no suitable keyseating machine for cutting the keyway, it was decided to perform the work on a 24-inch Bullard vertical turret lathe by making use of the vertical friction-driven head employed to raise and lower the turret slide. A standard boring-bar equipped with a high-speed steel tool bit, was used, and by taking light cuts the job was finished in a satisfactory manner.

New Britain, Conn. — W. C. BETZ

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

DETERMINING ALTITUDE OF AN ACUTE-ANGLED TRIANGLE

A. A. G.—Will you please show how to find the distances x and y from the dimensions given in the illustration?

ANSWERED BY LEO LAUBMEYER, HAMILTON, MICH.

The following method of solving the problem stated requires only an elementary knowledge of trigonometry and the use of a table of trigonometrical functions. Referring to the illustration,

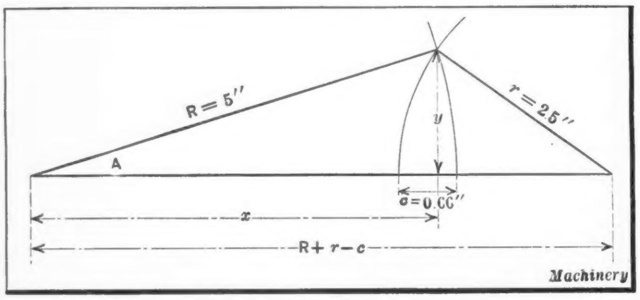


Diagram for calculating Distances x and y

$$R + r - c = 5 + 2.5 - 0.66 = 6.84 \text{ inches}$$

According to trigonometry (see MACHINERY'S HANDBOOK, page 152)

$$\operatorname{Cos} A = \frac{R^2 + (R + r - c)^2 - r^2}{2R\,(R + r - c)}$$

Substituting the known values and solving,

$$\operatorname{Cos} A = \frac{5^2 + 6.84^2 - 2.5^2}{2 \times 5 \times 6.84} = \frac{25 + 46.7856 - 6.25}{2 \times 5 \times 6.84}$$

$\operatorname{Cos} A = 0.9581228$ and $A = 16$ deg. 38 min. 24.8 seconds

$$\operatorname{Sin} A = 0.28636$$

$$x = R \times \cos A = 5 \times 0.9581228 = 4.790614 \text{ inches}$$

$$y = R \times \sin A = 5 \times 0.28636 = 1.4318 \text{ inches}$$

[While this solution involves the use of trigonometrical functions, it requires less mathematical computations than the one given in September MACHINERY, page 61. A solution similar to the one here given was also submitted by George Warmington, Beverly, Mass.—EDITOR]

ANSWERED BY GEORGE H. SUESS, PHILADELPHIA, PA.

The writer believes that the following solution to the problem submitted by A. A. J. is simpler and involves less calculation than the one given in September MACHINERY on page 61. Referring to the illustration we have:

$$x + N = R + r - c = 5 + 2.5 - 0.66 = 6.84 \text{ inches}$$

Also the sum of the two shorter sides is:

$$R + r = 5 + 2.5 = 7.5 \text{ inches}$$

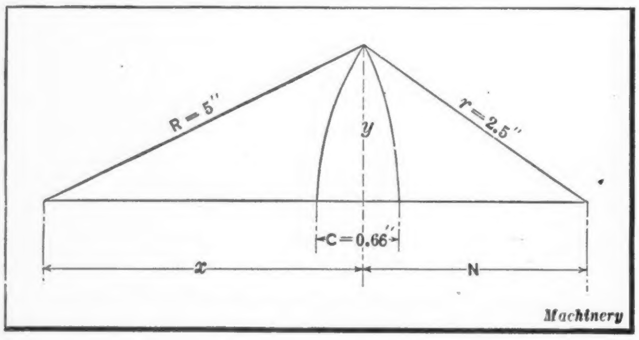


Diagram for determining Altitude y

and the difference between the two shorter sides is:

$$R - r = 5 - 2.5 = 2.5 \text{ inches}$$

Then

$$x + N : R + r :: R - r : x - N$$

or

$$6.84 : 7.5 :: 2.5 : x - N$$

Therefore

$$x - N = \frac{7.5 \times 2.5}{6.84} = 2.74123 \text{ inches}$$

According to arithmetic, if the sum of two numbers and their difference be given, the greater of the two numbers is equal to one-half the sum of their sum and difference.

$$x = \frac{(x + N) + (x - N)}{2} = \frac{6.84 + 2.74123}{2} = 4.79062 \text{ inches}$$

$$y = \sqrt{5^2 - 4.79062^2} = 1.43176, \text{ or } 1.4318 \text{ inches}$$

[Solutions similar to the one here given were also submitted by C. N. Pickworth, Manchester, England, and Herbert Bold, Ecorse, Mich.—EDITOR]

ANSWERED BY LEWIS D. CASTOR, ELIZABETHPORT, N. J.

This solution involves the application of a simple formula that is seldom given in handbooks, but which the writer has found useful in solving problems involving oblique triangles. Referring to the illustration, the formula is as follows:

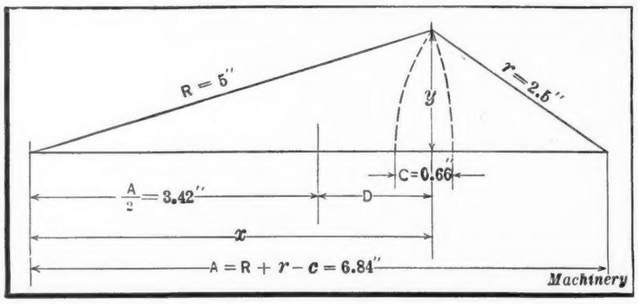


Diagram for determining Altitude of an Acute-angled Triangle

$$D = \frac{R^2 - r^2}{2A}$$

This formula is derived from the following equations:

$$\sqrt{R^2 - y^2} = \frac{A}{2} + D \qquad (1)$$

$$\sqrt{r^2 - y^2} = \frac{A}{2} - D \qquad (2)$$

Squaring both sides we have,

$$4R^2 - 4y^2 = A^2 + 4AD + 4D^2 \qquad (1)$$

$$4r^2 - 4y^2 = A^2 - 4AD + 4D^2 \qquad (2)$$

Subtracting (2) from (1) we have,

$$4R^2 - 4r^2 = 8AD \text{ or}$$

$$R^2 - r^2 = 2AD$$

$$D = \frac{R^2 - r^2}{2A}$$

Substituting the numerical values of the given problem,

$$D = \frac{25 - 6.25}{13.68} = 1.37061 \text{ inches}$$

$$x = 3.42 + 1.37061 = 4.79061 \text{ inches}$$

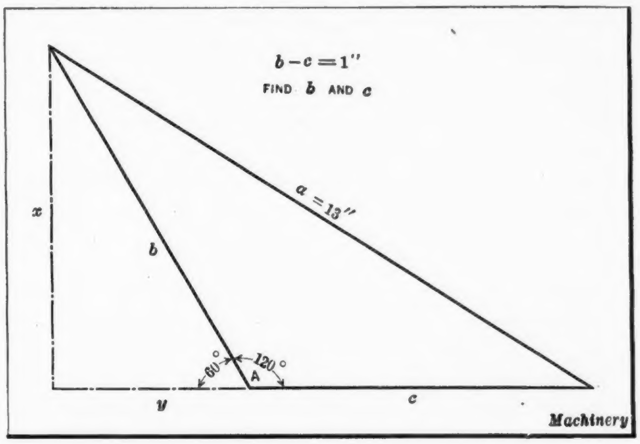
$$y = \sqrt{R^2 - x^2} = \sqrt{25 - 22.9441} = 1.4318 \text{ inches}$$

DETERMINING THE LENGTHS OF TWO SIDES OF AN OBLIQUE TRIANGLE

H. W. P.—The accompanying illustration shows an oblique triangle in which the difference between the lengths of sides b and c = 1 inch; the length of side a = 13 inches; and angle A = 120 degrees. How can the lengths of sides b and c be found?

ANSWERED BY J. W. JONES, CLEVELAND, OHIO

In the following are given two solutions, both of which the writer believes are simpler than that presented on page 238 of November MACHINERY. It will be noted that a well-known formula in trigonometry is employed in the first solution.



Oblique Triangle in which the Difference between Sides b and c, and Angle A are known

Solution by Trigonometry

Referring to the accompanying illustration:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Now as $\cos A = -\frac{1}{2}$, we have $a^2 = b^2 + c^2 + bc$

According to the conditions of the problem, $b = c + 1$. Therefore

$$a^2 = c^2 + 2c + 1 + c^2 + c^2 + c = 169$$

Then

$$c^2 + c = 56 \text{ and } (c + \tfrac{1}{2})^2 = 56\tfrac{1}{4} \text{ or } 225 \div 4$$

and

$$c + \tfrac{1}{2} = \frac{15}{2} = 7 \text{ inches and } b = 7 + 1 = 8 \text{ inches}$$

Solution by Geometry

Referring to the accompanying illustration, $x^2 + y^2 = b^2$; $y = \frac{1}{2} b$; and $b = c + 1$.

Further

$$a^2 = x^2 + (c + y)^2 = x^2 + c^2 + 2cy + y^2$$

and

$$a^2 = b^2 + c^2 + 2cy = c^2 + b^2 + cb$$

Then by substitution

$$a^2 = c^2 + c^2 + 2c + 1 + c^2 + c = 3c^2 + 3c + 1 = 169$$

Thus

$$c^2 + c = 56 \quad \text{and} \quad c^2 + c + \tfrac{1}{4} = 56\tfrac{1}{4} = 225 \div 4$$

and

$$c + \tfrac{1}{2} = \frac{15}{2} = 7 \text{ inches; } b = 7 + 1 = 8 \text{ inches}$$

FINISHING HANDWHEEL RIMS

B.—What method is employed in finishing the rims of machine handwheels?

A.—Ordinarily this operation is performed by turning on a lathe, followed by polishing, although the use of a rotary milling machine and a formed milling cutter is considered by some to be superior to turning. In one shop the polishing is done by spinning the handwheels on an arbor held by the hands, against a fabric wheel which is provided with a facing of abrasive. The surface speed of the rim is slackened to less than that of the buffing wheel by pressure against the workman's leather apron.

VOLUME SOLVED BY PAPPUS OR GULDINUS RULES

F. F.—Please show how to find the volume of the solid shown in the accompanying illustration, any cross-section of which, perpendicular to the axis, is circular. Length c = 18 feet, and the middle diameter d = 20 inches.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—Referring to the illustration, this solid is produced by the revolution of the segment of a circle XYZ about its chord XZ. The volume of any solid of revolution may be found by means of the Pappus or Guldinus rules given on page 144 in MACHINERY'S HANDBOOK.

Thus

$$V = 2\pi m A \tag{1}$$

in which

V = volume of the figure;
A = area of segment XYZ; and
m = distance from the axis of revolution to the center of gravity of segment XYZ

The area of a segment of a circle is found by the formula

$$A = r^2(\alpha - \sin \alpha \times \cos \alpha) \tag{2}$$

In this case,

$$r = \frac{c^2 + 4h^2}{8h} = \frac{46656 + 400}{80} = 588.2 \text{ inches}$$

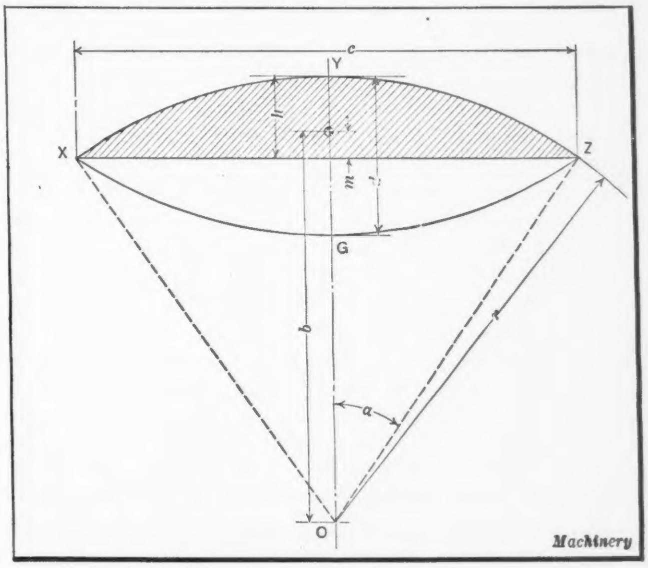


Diagram used to illustrate Method of calculating the Volume of a Solid of Revolution

$$\sin \alpha = \frac{c}{2r} = \frac{216}{1176.4} = 0.183611$$

α = 10 degrees 34 minutes 49 seconds
α (in radians) = 0.1846586

$$\cos \alpha = \frac{r - h}{r} = \frac{588.2 - 10}{588.2} = 0.982999$$

Inserting the numerical values in Formula (2), we get

$$A = 1442.46 \text{ square inches}$$

The distance from the center O to the center of gravity of the segment is obtainable by a formula given in MACHINERY'S HANDBOOK on page 267 which is as follows: $b = c^3 \div 12A$, from which we find b = 582.20539 inches.

Now

$$m = b - (r - h) = 4.00539 \text{ inches}$$

Inserting the numerical values for m and A in Formula (1), we find the volume of the solid to be 36,302 cubic inches or 21 cubic feet.

The Machine-building Industries

THERE are definite indications of a gradual resumption of activity in the machine-building industries and of a revival in buying of manufacturing equipment and tools. One of these indications is that some fair-sized orders have been placed for highly productive automatic and semi-automatic machinery, and another is that there is a steady increase in the volume of buying in the small tool field. It is generally recognized that the type of machine tool most likely to find a ready sale in the near future is one that it will be economical to buy, either because it gives greater production per dollar put into operating costs, or because it gives greater accuracy, or both. Much of the business done in this line of machinery during the present year will be replacement business—that is, the replacement of older types of machines by more efficient ones, in order to reduce manufacturing costs and improve the quality of the product.

The Effect of Improved Machinery

Examples of the effect of installing high-production machinery are growing more numerous every day. A case recently noticed was the production of a part used in great quantities, which is now being turned out at the rate of 1½ minutes, compared with 7 minutes by the older equipment. New equipment of this type was installed in one factory with the result that the manufacturer was enabled to undersell his competitors immediately, and now his competitors are negotiating for similar equipment, this being the only solution of their problem.

In another case an automatic machine which cost $7000 is producing parts in 40 seconds which used to require 3 minutes on a $12,000 machine. Still another interesting comparison will illustrate the point. By former methods an automobile manufacturer employed ten machines and eight men for the machining operations on one of the important parts of his engine. The total cost of the equipment was $25,000. This equipment has been replaced by modern automatic machinery at a cost of only $15,000, and two men and two machines are giving the same production as was formerly obtained. The quality of the product has not suffered.

These examples indicate better than general statements the lines along which there are possibilities for developing business in the machine tool field. The great need and the demand today is for the highly productive automatic or semi-automatic machine that will replace the less productive machinery of former days and relegate it to the scrap heap.

The Small Tool Industry

The increased buying in the small tool field constitutes one of the most cheerful signs at the beginning of 1922, although this industry is operating only at about 30 to 40 per cent of capacity. Most of the manufacturers of small tools continued to operate with full, or nearly full forces, for several months—in many cases for half a year—after the depression had started, and for that reason their stock-rooms are well filled. They are able to fill present orders chiefly from these stocks, so that the shops run mainly on special orders.

One of the plants manufacturing small tools reports 1921 sales equal to 45 per cent of the 1920 business; another reports 42 per cent; while the average of the majority of plants in this field is about 35 per cent. In most cases the lowest point in the small tool business was reached in June and July last year, and one of the important concerns in the field reports that December, 1921, and January, 1922, both showed increased sales over the corresponding months of a year ago. One concern equalled its 1916 business in 1921, and there are many reasons for the belief that 1922 will equal the 1917 business. There has been an improvement in exports too, especially to Australia. In the small tool field it is confidently expected that March will show up unusually well, compared with the last eighteen months. One of the plants has added 10 per cent to its force and increased the working hours about 30 per cent, compared with January 1.

In the grinding wheel field, similar conditions exist. There are numerous orders, although each is small, but the tendency now is toward bigger orders. For example, one well-known manufacturer who used to order about 250 wheels at a time two years ago but who cut down his orders to a dozen at a time, has recently increased them to 50 wheels per order, which is encouraging.

The Machine Tool Situation

In the machine tool field immediate prospects are not quite so promising, but they are very much brighter than at any time during the last eighteen months. Many new ideas are being worked out, new machines are being developed, and practically every machine tool builder has something new in mind. These new machines with their valuable new features will make it hard for manufacturers to keep on operating with old equipment. In the meantime, many machine tool builders are turning to other fields in order to utilize the excess capacity of their plants. Machines being built in machine tool works at the present time include printing machinery, laundry machinery, domestic washing machines, ice cream freezers, automatic refrigerators, motorcycles, and Diesel engines.

Stability in machine tool prices seems to have been reached in most instances, substantial reductions having been made from time to time during the past year. An investigation made by MACHINERY into the condition of the used machine tool market definitely shows that the fear that second-hand machine tools will seriously interfere with the sale of new equipment is not well founded. While there are many second-hand machines on the market, most of them are of old types, and as business improves many of them will be scrapped—they cannot compete with the later and far more efficient equipment available. A complete review of this situation will be found on page 539.

The Automobile Industry—The Railroad Situation

In this review, in February MACHINERY, it was stated that the total number of passenger cars and trucks built in 1921 was 1,680,000, a decrease of 24 per cent from the production in 1920. The factory prices of these cars and trucks aggregated $1,222,350,000, which was 45 per cent less than the factory prices of 1920. The average factory price of an automobile in 1921 was $702, compared with $897 for the previous year. The average factory price of motor trucks in 1921 was $968, as against $1273 in 1920. Automobile manufacturers are moving cautiously, and are not planning any material increase in production until there is greater evidence of a steady and increasing market. There has been a slight increase in exports of both passenger cars and motor trucks, but these exports are still far below the 1920 figure.

The greatly improved financial results during the last six months are encouraging; and as equipment and supplies in general have materially decreased in price, a considerable number of orders has been placed by the railroads in the last few months. Rolling stock can now be purchased at from 30 to 35 per cent less than peak prices, and the contracts for locomotives and cars placed during December and January are providing substantial employment for several of the shops in this field.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Peerless Universal Shaping Saw

A UNIVERSAL shaping saw having the general characteristics of a hacksaw machine, but designed along lines that adapt it for many operations impossible to perform with the common type of hacksaw machine, is being introduced to the trade by the Peerless Machine Co., 1611 Racine St., Racine, Wis. From Figs. 1 and 2 it will be seen that this saw is built to machine tool standards, accuracy in construction being essential to fit the machine for the class of work for which it is intended. Samples of the work that is handled by this machine are illustrated in Fig. 3.

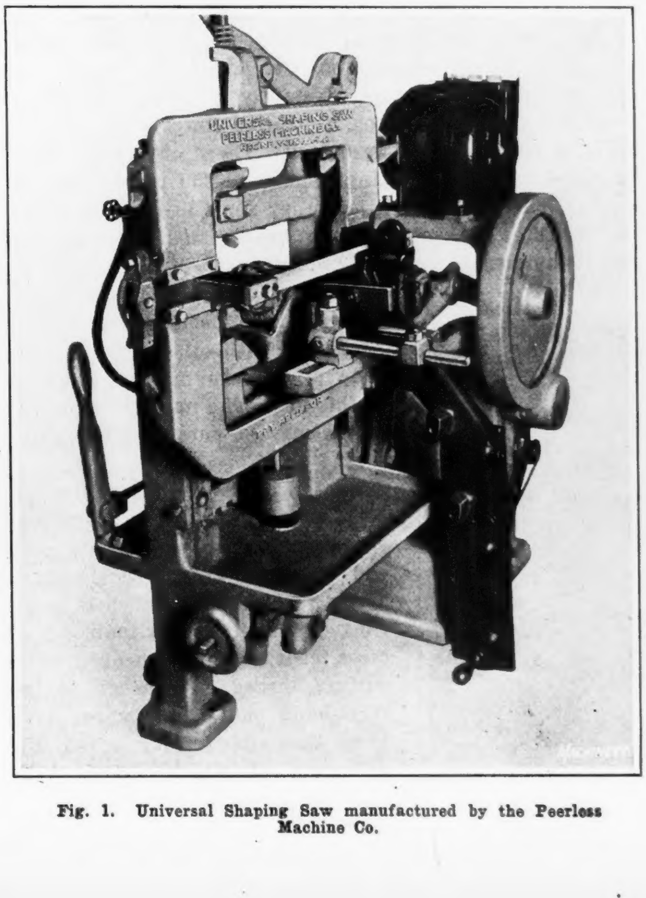


Fig. 1. Universal Shaping Saw manufactured by the Peerless Machine Co.

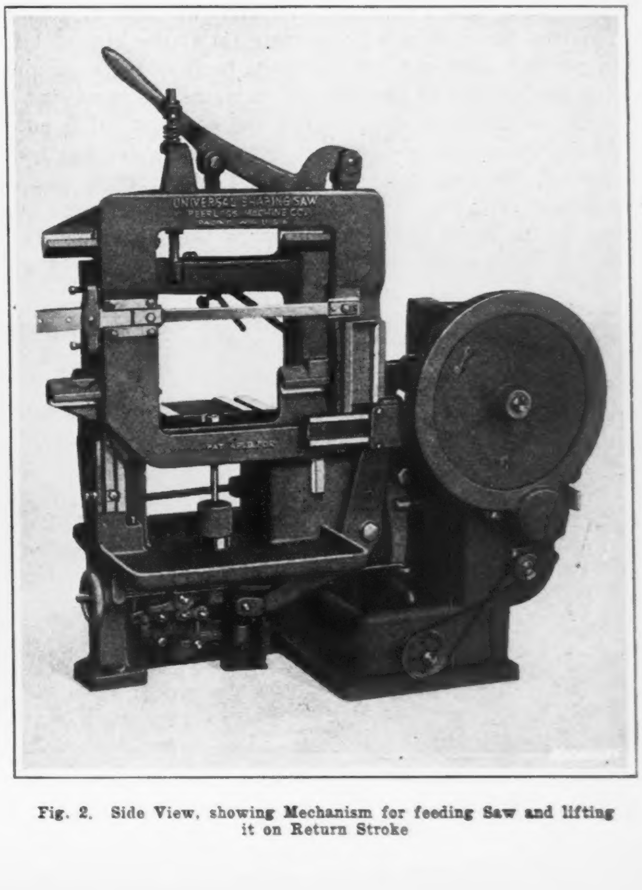


Fig. 2. Side View, showing Mechanism for feeding Saw and lifting it on Return Stroke

The saw blade is carried by a four-sided frame which permits the blade to be placed under ample tension without danger of distorting the bearings. The saw frame is supported on the horizontal bearings or ways of a vertical slide which, in turn, is mounted on vertical ways on the main frame of the machine. The saw frame is reciprocated through a crank and connecting-rod, and during the draw or cutting stroke of the blade the connecting-rod is always approximately parallel with the line of blade travel. This gives a direct pull on the blade and allows the cutting stroke to take place when the angle of the crank is such that the cutting speed is reduced to the minimum of the cycle period, although this speed is the maximum suitable for the work being handled. Then, during the return stroke, the change in the angularity of the crank causes the blade to be returned to the starting point at a high rate of speed. A speed-box having a cone of gears provides three changes of cutting speed to meet the requirements of different jobs.

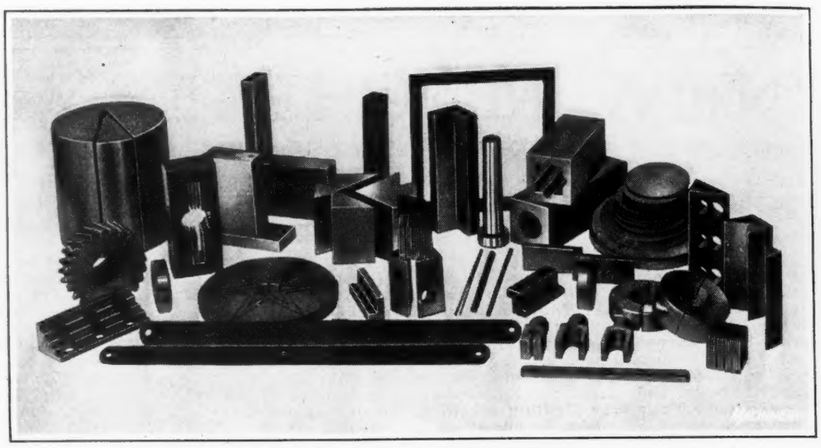


Fig. 3. Typical Examples of Work cut on the Peerless Universal Shaping Saw

Another important feature of this shaping saw is the positive power-feed mechanism with which it is provided. At the end of the draw or cutting stroke, a cam on the crankshaft actuates a lever, which raises the vertical slide on which the saw frame reciprocates and thus lifts the blade clear of the work while the saw is being returned to the starting position. After it has been returned, the saw is lowered to the cutting position by means of the same cam and lever. Simultaneously, a second cam on the crankshaft becomes operative, and through a link and lever mechanism and a ratchet and pawl, a worm meshing with a rack connected to the vertical slide on which the saw frame is mounted, is turned in such a way that it pulls the rack and saw frame down slightly. The repetition of this cycle of movements at the beginning of each cutting stroke provides for feeding the saw into the work at a predetermined rate. The rate of feed is adjusted by turning the small handwheel near the base at the front of the machine.

The feed is regulated automatically by a spring that compensates for the resistance of the material being cut. For instance, if a feed pressure of a certain number of pounds is required for cutting a given material at the rate of 1/32 inch per cut, each cut will be made to that depth as long as the composition of the material remains the same, but if a harder substance is encountered, the depth of cut is automatically decreased proportionately. When a cut has been completed, the feed worm is automatically tripped out of engagement with the rack, after which a spring lifts the saw frame to its upper position and stops the machine. This makes it unnecessary for an operator to watch the work.

For the performance of angle-cutting operations, a special fixture is furnished on which the work may be clamped to either a horizontal or a vertical face. A typical angle-cutting operation is illustrated in Fig. 4. Another useful fixture which adds to the range of the machine is a cross-feed mechanism secured to the table. A piece of work can be placed in this fixture and fed transversely under the reciprocating saw, the latter acting much like a shaper tool and producing a smooth finish on the surfaces machined. Fig. 5 shows a job accomplished by means of this mechanism, a screw-adjusted depth gage being employed for controlling the downward movement of the saw blade.

A reservoir in the base of the machine may be filled with a cooling solution for delivery in a copious amount by a pump and piping to the saw blade and work, after which it is returned to the reservoir. The machine has a capacity for work 6⅝ inches square, takes blades from 10 to 14 inches in length, and has a stroke of 5½ inches. The maximum number of strokes per minute is 132, and the minimum number 50. When equipped with a standard vise, the machine weighs approximately 750 pounds.

BOYE & EMMES CONELESS ENGINE LATHE

The 18-inch geared-head engine lathe shown in the accompanying illustration is being introduced to the trade by the Boyé & Emmes Machine Tool Co., Cincinnati, Ohio. All gears in the headstock are constantly in mesh, the various speeds being obtained through positive clutches operated by means of levers on the headstock. There are twelve selective spindle speeds, ranging from 9 to 350 revolutions per minute. The drive from the pulley shaft is through a friction clutch. The spindle is a heat-treated chrome-nickel steel hammered forging. The top cover of the headstock has a removable plug which affords a convenient means of filling the headstock with oil, a glass oil-tube showing the level of oil at any time in this unit. The number of threads which may be cut per inch ranges from 2 to 56.

The apron is of the double-plate type, which permits the shafts and studs to have a bearing on each end. All feeds are reversible in the apron, and the mechanism is so arranged that the longitudinal and cross feeds cannot be engaged while cutting threads. Attached to the right-hand end of the apron is a lever that slides along a rod, the operation of which controls the starting, stopping, and reversing of

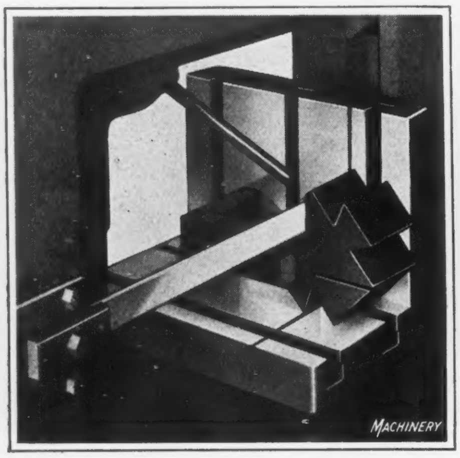


Fig. 4. Cutting Angular External Surfaces

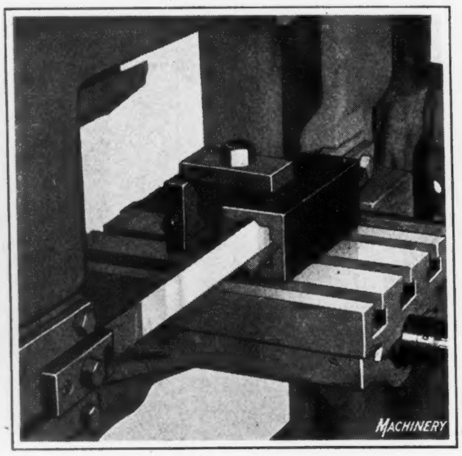
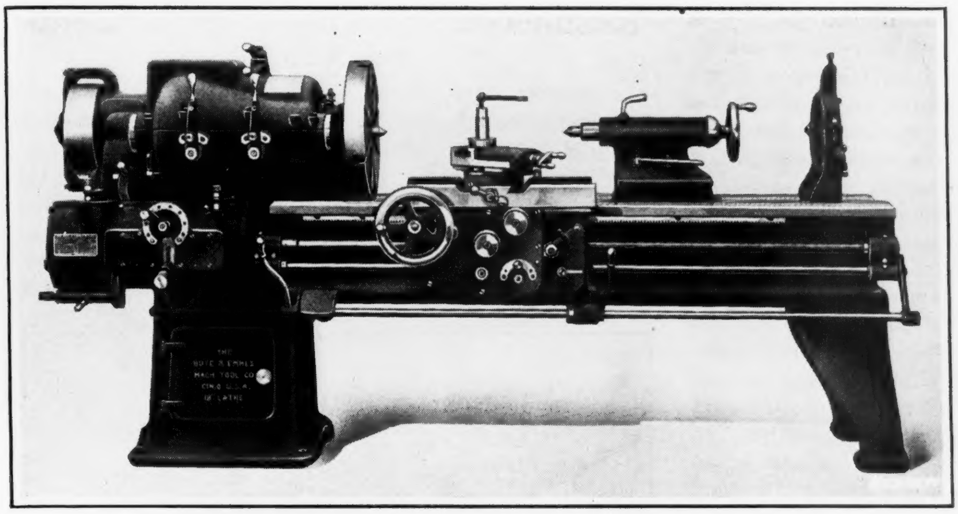


Fig. 5. Use of the Cross-feed Mechanism



Coneless Engine Lathe built by the Boye & Emmes Machine Tool Co.

the headstock spindle. A second lever is mounted on this controller rod at the left-hand end. The tailstock is of the cut-away type, so as to permit the compound rest to be swiveled parallel with the ways of the bed. Double plug clamps are employed to lock the tailstock spindle in position. This spindle is also made from chrome-nickel steel and accurately ground. The tailstock has a sidewise adjustment to provide for taper-turning operations.

The motor is attached to a baseplate mounted on two planed surfaces on the back of the cabinet leg. Constant-speed motors of from 3 to 5 horsepower, and of a speed not exceeding 1160 revolutions per minute are recommended for driving this machine. Its principal dimensions are as follows: Actual swing over bed, 19½ inches; swing over carriage, 13¼ inches; diameter of hole in headstock spindle, 1½ inches; distance between vees of carriage, 14 inches; and distance between centers on a lathe having an 8-foot bed, 4 feet 2 inches. This lathe, when furnished with an 8-foot bed, weighs about 4275 pounds.

LANDIS PIPE THREADING AND CUTTING MACHINE

A pipe threading and cutting machine recently added to the line of products manufactured by the Landis Machine Co., Waynesboro, Pa., is shown in the illustration. This machine may be equipped for threading oil-well casing and high-pressure pipe in addition to ordinary line pipe. It regularly accommodates from 4- to 12-inch pipe, but it may be equipped to thread and cut pipe as small as 2½-inch. Two die-heads of the stationary type are employed, a 6-inch die-head for pipe less than 6-inch, and a 12-inch die-head for pipe ranging from 6- to 12-inch. The entire range of each of these heads is covered by one set of Landis chasers. The chucks for gripping the pipe have three jaws; these jaws are geared, have universal adjustment, and are self-centering on the pipe. The rear chuck is equipped with grips to provide for fitting up flanges.

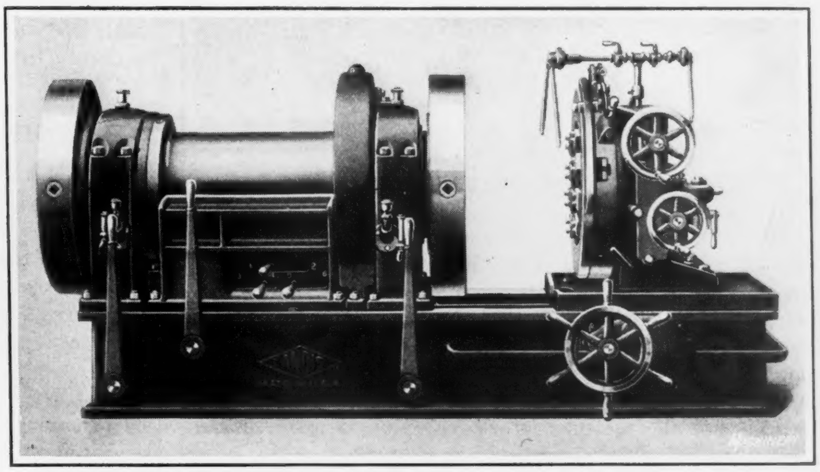
The carriage supports the die-head, cutting-off tool, and reaming tool, and may be moved either by power or hand. Both forward and backward power traverses are controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the chuck, this lever is operated and held until the threading position for the die-head is reached. To reverse the movement of the carriage, the lever is moved in the opposite direction and held there. The carriage may be stopped at any point along its traverse by releasing the lever. Automatic stops prevent the die-head from coming in contact with the chuck in the forward movement and the carriage from running off the guides of the machine in the backward movement. The reaming tool is quickly set to the desired position and locked by means of a lever, and it is fed to the pipe by rotating the cutting-off feed handwheel in a counter-clockwise direction.

The machine has a single-pulley drive, eight speeds being obtainable through a gear-box under the main spindle, by shifting levers located on the side of the gear-box. The machine is started and stopped through a friction clutch operated by either one of two levers at the ends of the headstock. This arrangement enables the operator to stop or start the machine conveniently when threading or when fitting up flanges. The lever midway between the starting and stopping levers is manipulated to reverse the operation of the machine. A motor drive may be quickly arranged by substituting a sprocket for the pulley and fitting a plate to the side of the machine for mounting a motor, a silent chain being used to drive from the sprocket on the motor to the sprocket on the machine. The machine weighs 13,000 pounds.

STEVENSON DOWN-STROKE GEAR SHAPER

A gear shaper made by the Stevenson Gear Co., Indianapolis, Ind., on which all or a number of the teeth of a spur gear, sprocket, etc., are cut simultaneously by a tool-head having a series of radially disposed tools spaced about the circumference of the blank to be cut was described in August, 1921, MACHINERY. It will be recalled that in this machine the tools are fed radially after each reciprocation of the work-holding ram, at which time the work is also indexed a distance of one tooth space. The tool-head is placed above the ram so that the gear blanks are cut on the upward stroke. As the work-holding arbor is passed through the tool-head in putting work in place, the machine is suitable for cutting plain work only. To accomplish the rapid cutting of internal and cluster gears and splines, the same company has developed the machine shown on the following page.

This machine is known as Model 6-A, and is of a down-stroke type; that is, the tool-head is placed beneath the ram and the teeth are cut on the downward stroke instead of on the upward stroke as in the machine referred to. On the

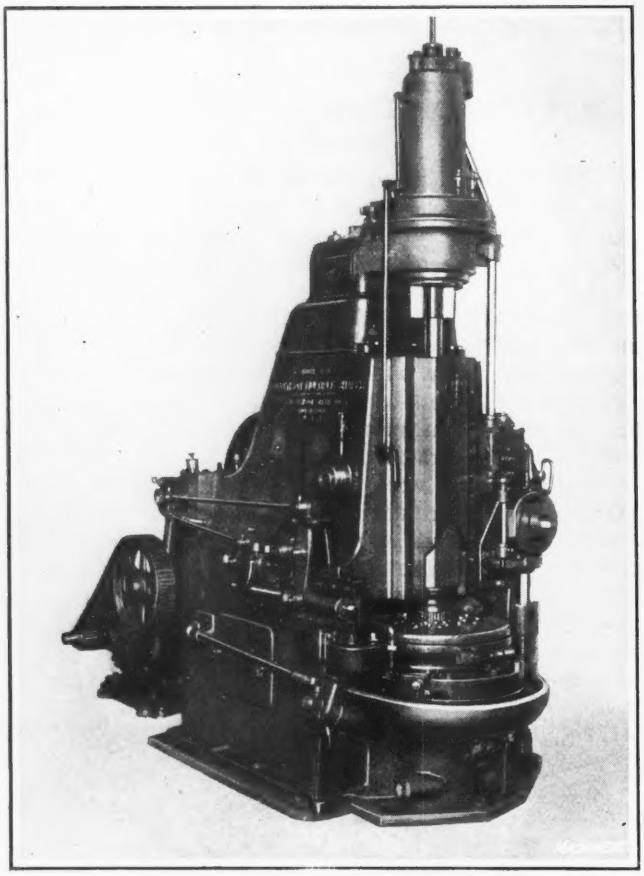


Twelve-inch Pipe Threading and Cutting Machine brought out by the Landis Machine Co.

new machine, the ram is elevated a sufficient distance to enable the arbor of completed gears to be removed and an arbor of blanks to be inserted in the spindle socket of the ram. After the taper shank of the arbor has been inserted in the socket, the operator, by means of a convenient lever, engages a power-driven clutch, which causes a draw-bolt passing through the center of the spindle to revolve and securely draw the arbor into the socket. This clutch is automatically disengaged the moment that the arbor has been tightened a predetermined amount.

After the ram has again been lowered by power to the operative position, at which point it stops automatically, the operator starts the machine by means of an electric push-button switch. As the entire machining operation is automatic, the operator has sufficient opportunity to place blanks on a second arbor while the machine is in operation. In this manner an arbor of cut gears may be replaced by an arbor of blanks with a minimum loss of time. At the completion of an operation the machine is stopped by means of a push-button switch that controls an electric brake. The operator then temporarily elevates the ram, reverses the draw-bolt lever previously mentioned, to eject the arbor, after which the procedure is the same as before.

The tool-head is almost identical with that used on the up-stroke machine, the tool bits and other important parts being interchangeable on the two machines. Two tool-heads are provided, so that while one is in use, the tools of the other may be resharpened and reset. The mechanism for

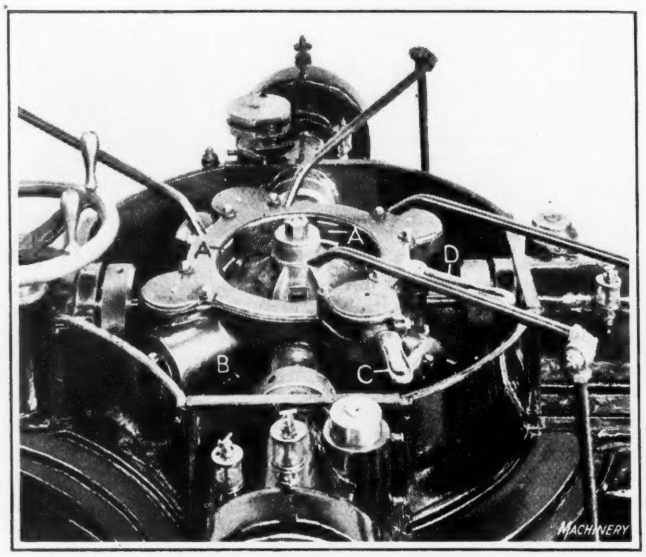


Model 6-A Down-stroke Multiple-tool Gear Shaper designed by the Stevenson Gear Co. for cutting Internal and Cluster Gears

driving the ram and elevating and lowering it consists of a crank which reciprocates a worm during the operation of the machine. This worm transmits its reciprocatory movements through a worm-wheel mounted on a rock shaft. However, when it is desired to elevate the ram, the worm is kept from reciprocating and given a rotary movement, causing the worm-wheel and rock shaft to revolve and elevate the ram. Power for this rotary movement is derived from a small motor which also furnishes power for actuating the draw-bolt mechanism. This machine will be built in a number of sizes.

REED-PRENTICE FOUR-WAY DRILLING MACHINE

In October, 1914, MACHINERY, was described a four-way drilling machine built by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., for simultaneously drilling four holes in automobile universal-joint rings and for turning the four arms of differential spiders. This machine has now been built for drilling four bearing holes in the upper and lower sections of tractor rear-axle housings, a special work-holding fixture being provided, which has several novel fea-



Work-holding Fixture of Special Four-way Drilling Machine built by the Reed-Prentice Co.

tures that permit rapid handling of the work. Four hardened steel strips *A* placed around the inside of this fixture locate the work centrally, while the bosses in which the bearing holes are to be drilled are properly located by means of guide pins in the lower part of the fixture which engage two holes previously machined in the flanges of the housing members.

The lower half of the housing is dropped into position first, after which four plungers in bearings spaced 90 degrees apart, as at *B*, are forced toward the center of the fixture by operating lever *C*. The second or upper half of the housing is then placed in the fixture and the work clamped tight on the plungers by means of a center bolt that passes through both housing members. This arrangement supports the work rigidly during the drilling operation. When this has been completed, the upper housing section is removed, and after withdrawing the four main plungers, the lower half is raised by operating lever *D* to actuate four vertical plungers which bring the lower half of the housing into a position from which it is easily lifted out of the fixture. Hardened steel bushings inserted in the main body of the fixture guide the drills properly and insure accuracy in drilling the bearing holes.

HANNIFIN ADJUSTABLE BORING-BARS

A complete line of boring-bars in which the cutters can be accurately adjusted by means of a scroll has been developed by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., for rough- and finish-boring, reaming, and line-reaming operations. Various combinations of standard cutters may be included in one bar for boring to different diameters, counterboring, and facing in one operation. By using angle- and straight-type cutters, several sets can be spaced close together on a bar. This possibility will be apparent by reference to Fig. 1, which shows the front end of a bar equipped with sets of angular and straight cutters. A phantom detail view of the angle-type cutter is shown in Fig. 2, while Fig. 3 shows a similar view of the straight type.

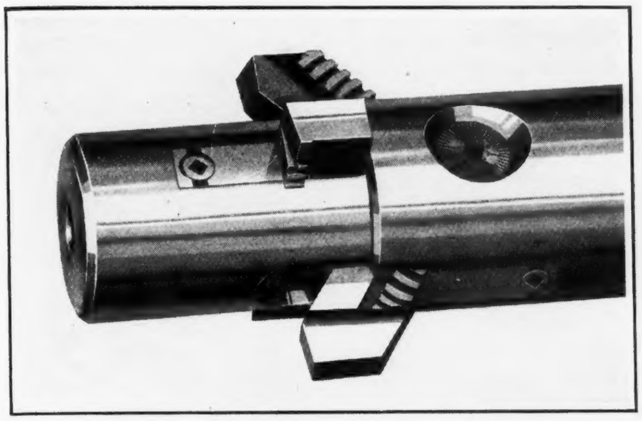


Fig. 1. End of an Adjustable-cutter Boring-bar made by the Hannifin Mfg. Co.

One side of the cutters is provided with curved teeth for engagement with the thread of a scroll, and as the latter is revolved by applying a wrench in the square hole at its center, the cutters are either advanced or drawn back. Graduations on the scroll enable accurate settings to be made, and two locking screws are utilized to keep the cutters in position. The inner ends of the cutters overlap each other, which permits greater expansion and rigidity. The cutters are backed metal to metal and cannot work loose.

The angle-type cutters are particularly adapted for facing and counterboring operations, because they are also adjusted forward as they are adjusted radially. Grinding the cutter faces after they have been set out, keeps them in the original position. This style of cutter is also especially suitable for boring to the bottom of blind holes. With a combination of the angle and straight types, the cutters can be adjusted

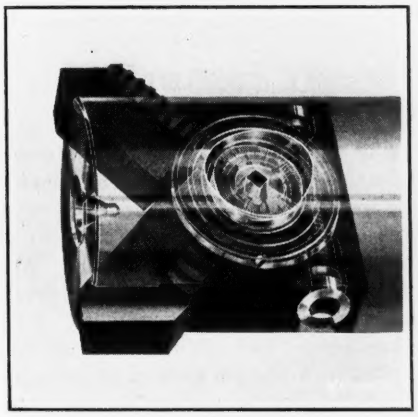


Fig. 2. Phantom View, showing Construction of the Angle-type Cutter

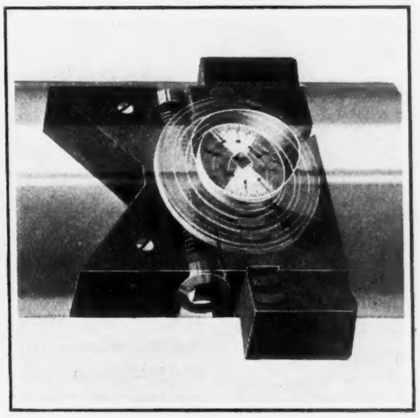


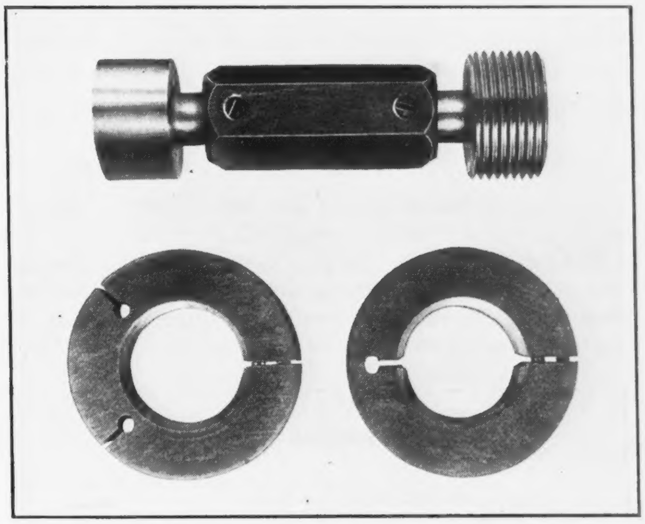
Fig. 3. Adjustable and Locking Details of the Straight-type Boring-bar Cutter

to machine to a common diameter, thus making a four-point cutting tool. The cutters are quickly replaceable and adjustable to size without removing the bar from the machine.

This company also manufactures boring-bars in which the blocks holding the scroll-adjusted cutters may be quickly removed from the bar to permit the substitution of another block having cutters for a different operation. By this arrangement rough-boring, finish-boring and reaming may be rapidly performed in succession without removing a bar from the machine. Bars with these removable blocks are particularly adapted for the line-boring and reaming of crank-cases and transmission cases, and the rough- and finish-boring of cylinders. Strip pilots can be furnished on any bar, and when worn they may be shimmed up and reground to fit the pilot bushing. Boring-bars can also be provided with hardened and ground pilots. In addition to line boring-bars, the company makes straight- and taper-shank boring-bars suitable for use on turret lathes, drilling machines and engine lathes. The angle-type, straight-type and removable block cutters are regularly made in different sizes for boring and reaming holes from 1 to 10½ inches in diameter.

PLUG AND TEMPLET THREAD GAGES

A line of plug and adjustable templet thread gages, several of which are shown in the accompanying illustration, is being placed on the market by the Superior Thread Gage Mfg. Co., Inc., 1985 Troy Ave., Brooklyn, N. Y. The templet gages are made in two styles, either with one half-way slot on the inside of the gage, or two half-way slots leading to the periphery. The latter style furnishes a fuller contact

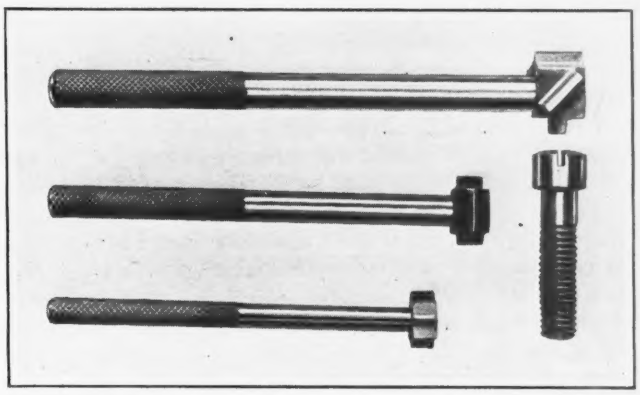


Thread Gages manufactured by the Superior Thread Gage Mfg. Co., Inc.

for the threads of the work, a feature of interest especially to the users of small-size gages. The plug gage is fitted at one end with a thread plug, and at the opposite end with a plain plug equal in diameter to the root of the thread that it is intended to gage. These plugs are readily replaceable as they become worn. The gages are regularly made for all sizes of standard threads, U. S. standard, Whitworth, S. A. E., etc., from 3/16 inch in diameter up. They can also be made for special threads.

PORTER OFFSET SCREW-DRIVER

The assembly or disassembly of machine parts is often difficult due to the fact that the holding screws are located so close to walls or projections that an ordinary screwdriver cannot be readily engaged in the screw-head slot. To enable a machinist to reach such screws conveniently, the Porter Products Corporation, Keith Theater Bldg., Syracuse, N. Y., has brought out the offset screwdrivers shown in the illustration. Each screwdriver consists of a handle having a square forged end. On the four sides of this end are long, narrow projections with which the slots

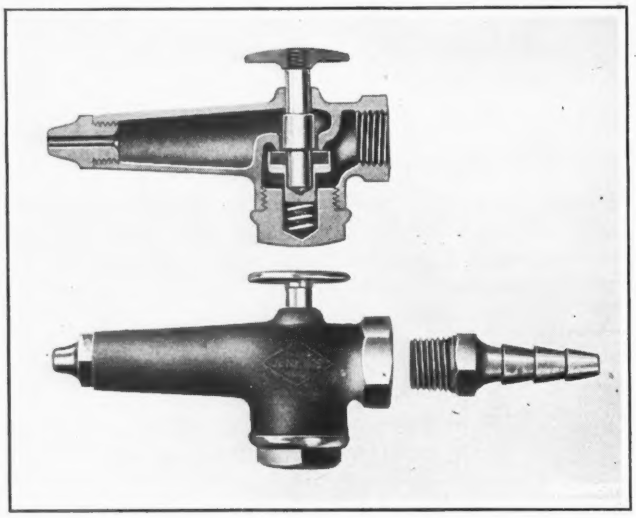


Offset Screwdriver Set made by the Porter Products Corporation

of screw-heads may be engaged. In use, the handle is held at right angles to the screw axis. The projection on any of the four sides is at an angle of 45 degrees to the projection on each of its adjacent sides. Therefore, if a screw is located in a cramped position, after turning the screw as far as space will permit, the screwdriver is given a quarter turn by the fingers and again applied. The screwdriver may be used in places so cramped that only an eighth turn of the screw is possible at a time. The design also has the advantage of enabling a considerable leverage to be applied to screws rusted in place. The manner of using this screwdriver will be understood by referring to the machine screw shown in the illustration.

JENKINS AIR GUN

A brass compressed air gun now being placed on the market by Jenkins Bros., 80 White St., New York City, finds application in machine shops for blowing chips and dirt from the tables of machines, and cleaning taps, dies, and other tools. To eliminate loss of air through leakage, the gun is designed with a disk that can be readily renewed as



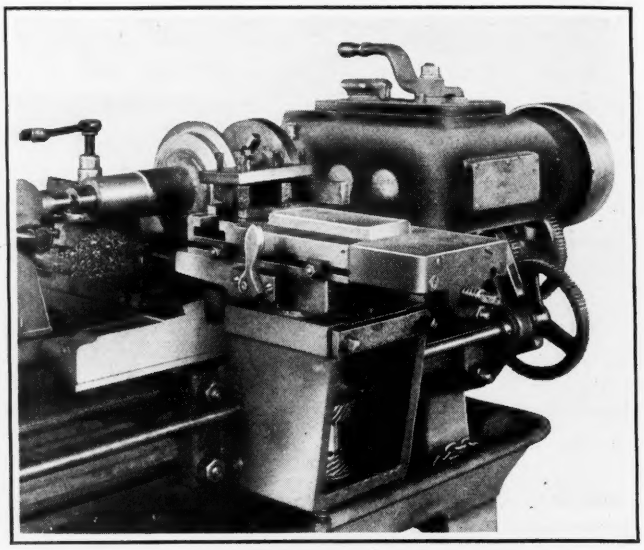
Compressed Air Gun for blowing Chips from Machines, etc., which is made by Jenkins Bros.

it becomes worn after removing the cap at the bottom of the gun. The sectional view in the illustration clearly shows the gun construction. Air is allowed to pass through the device when the user presses on the knob at the top, and the moment pressure is released from this knob, the coil spring at the bottom forces the disk previously referred to upward and against its seat, thus shutting off the passage of air. The gun may be used with $\frac{1}{8}$-, $\frac{1}{4}$-, $\frac{3}{8}$-, and $\frac{1}{2}$-inch hose by providing the proper size nipple. A nipple of the type used is shown to the right in the lower part of the illustration.

BACK-FACING ATTACHMENT FOR ADAMS "SHORT-CUT" LATHE

To accomplish the back-facing of work at any desired angle, the Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y., has recently brought out a universal power-operated back-facing attachment intended for use on the Adams "Short-cut" lathe. The attachment is especially suitable for turning bevel gears. It is a simple matter to set the device for machining the gear to the proper angle, the bevel surfaces being machined simultaneously with the turning of the gear hubs. Nine in-feeds are obtainable, ranging from 0.003 to 0.050 inch per spindle revolution. These feeds are secured through gearing connected to a splined shaft at the rear of the machine.

Reversal of the mechanism is accomplished by sliding positive clutches which engage with worm-gearing. There are

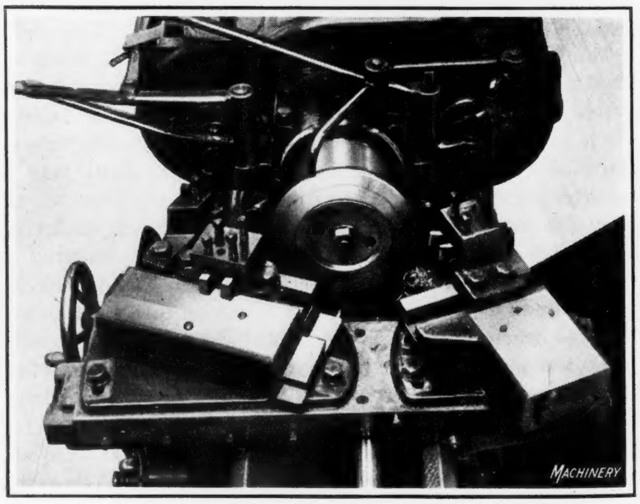


Back-facing Attachment made by the Seneca Falls Mfg. Co., Inc., for Use on the Adams "Short-cut" Lathe

twenty-seven automatic reverse feeds, ranging from three to fifteen times the forward feed that happens to be engaged. These feeds enable the operator to secure the proper timing necessary for back-facing, necking, under-cutting, and grooving work. The in-feed stop causes the mechanism to reverse automatically while the out-feed also stops automatically at the completion of a cycle. The back-facing tool is actuated by a screw and nut arrangement, which gives a smooth even motion. The relation of the back-facing feeds to the turning and facing feeds of the lathe permits innumerable combinations and puts the lathe into the semi-automatic class because, when equipped with this device, several machines may be run by one operator.

WARNER & SWASEY TURRET LATHE ATTACHMENT

The rapid machining of forged bevel gear blanks sometimes presents a troublesome problem to automobile manufacturers, because of the special metals from which the gears employed in automobiles are generally made. To facilitate such operations, the Warner & Swasey Co., Cleveland, Ohio, has brought out the attachment illustrated, which is adaptable to the No. 3-A universal hollow hexagon turret lathe manufactured by this concern. The attachment has two tool-slides and interchanges with the top slide of the regular carriage, so that the machine may be used either for bevel gears or for the other classes of work regularly handled on the turret lathe. The attachment is suitable for machining work up to 14 inches in diameter to all standard angles.

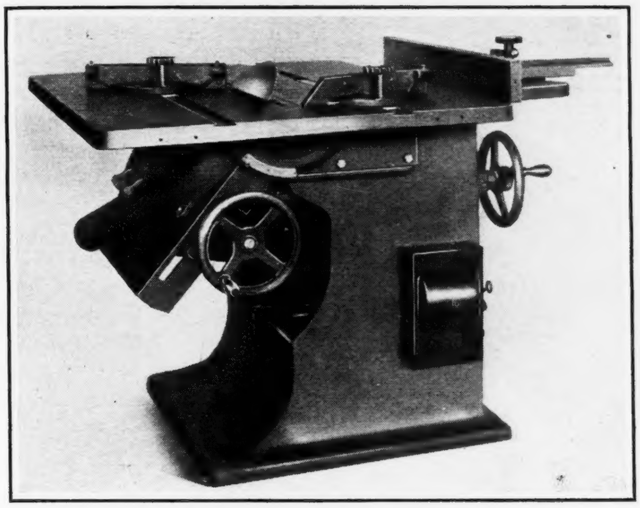


Attachment for machining Bevel Gear Blanks on a Turret Lathe built by the Warner & Swasey Co.

The two tool-slides are operated by the hexagon turret and saddle. A rack extending forward from the turret engages a double pinion on the attachment, and when the turret is advanced, this double pinion drives a second rack, transmitting a sliding motion to it, toward the rear of the machine, and causing it to rotate two other double pinions which drive racks fastened to the tool-slides. Thus, the two tools operate simultaneously.

TANNEWITZ TILTING-ARBOR SAW

A wood-cutting saw on which the saw arbor can be tilted to any angle up to 45 degrees, and which is therefore particularly adapted for service in pattern shops, is a recent product of the Tannewitz Works, Grand Rapids, Mich. The table of the machine is always in a horizontal plane. The tilting of the arbor is accomplished by operating the handwheel at the right, which is also used to lock the arbor in the positions to which it is adjusted. The handwheel at the left is employed to raise and lower the table, and lock it in place. The motor and saw are mounted on a sliding bracket



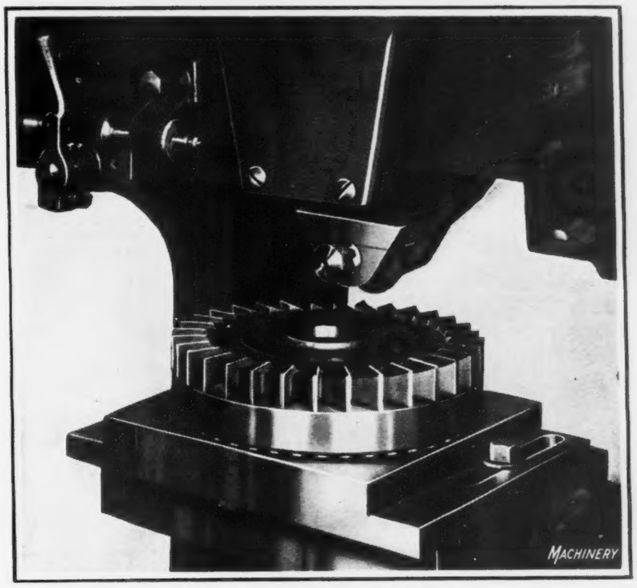
Saw developed by the Tannewitz Works for cutting Wood at Any Angle up to 45 Degrees

which is supported by a yoke, the latter being hinged on the housing. The motor has a speed of 3600 revolutions per minute, and is operated by an enclosed safety switch mounted on the outside of the housing. A complete set of graduated gages forms part of the equipment.

MARTIN HYDRAULIC MARKING MACHINE ATTACHMENT

A hydraulically operated machine built by the Martin Machine Co., Inc., Turners Falls, Mass., for the rapid marking of names, trademarks, etc., on metal products was described in detail in February, 1918, MACHINERY. Attachments recently developed for this machine enable marking to be done around a circle on the flat sides of cutters, rings, and similar parts, as shown in the illustration. The object to be marked is placed on a fixture mounted on the table of the machine, the top of this fixture being free to revolve on ball bearings. The fixture can be adjusted for marking to any radius, so that the marking will conform to the space provided on the work.

A plain roll die is used, and it is held in one position and revolved about its axis by means of a rack fastened to the slide of the machine. As the work is brought into contact with the revolving die, the top plate of the fixture is revolved. A plug set into the center of the revolving plate and fitting the bore of the work keeps the latter in the proper position. At the end of a marking stroke, the die is returned to its starting position by the return stroke of the slide.



Circular Marking Attachment for Machine manufactured by the Martin Machine Co.

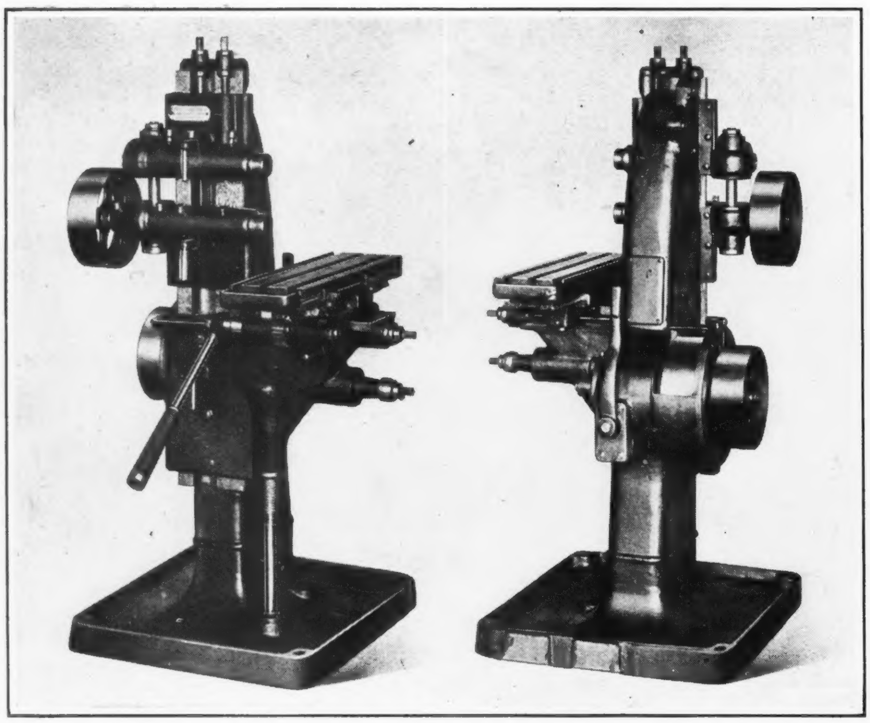
The hydraulic operation of the table results in satisfactory marking, regardless of variations in the thickness of the work.

REED INSIDE MICROMETER CALIPERS

An inside micrometer set having five rods that enable measurements to be made ranging from 3 to 8 inches, in increments of 0.001 inch, is now being introduced to the trade by the Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. This set will be found useful not only in determining the internal diameters of cylinders and rings, but also in taking linear measurements, testing the parallelism of surfaces, comparing gages, etc. The barrel, spindle, and thimble are similar in construction and diameter to like members of the outside micrometer made by this company. A feature of this micrometer is the provision of a detachable handle, which may be instantly set to permit easy reading of the graduations, whether the work is right- or left-hand.

The extra rods allow quick changes to suit the length of the part to be measured, the substitution being made by simply unscrewing the rod on the threaded stud of the barrel and then screwing the proper rod in place. Each rod is ground square at the hardened end so as to seat in the proper relation to the barrel shoulder. The point of measurement is fitted with a hardened tool-steel anvil which is adjustable to lengthen the rod and to compensate for anvil wear. The faces of the anvils are ground to a small radius. Rods of lengths permitting measurements other than in the range specified can also be supplied.

Set of Inside Micrometer Calipers added to the Line of Measuring Instruments made by the Reed Small Tool Works



Front and Rear Views of a Double-spindle Hand Milling Machine brought out by the Superior Machine & Engineering Co.

DUPLEX HAND MILLING MACHINE

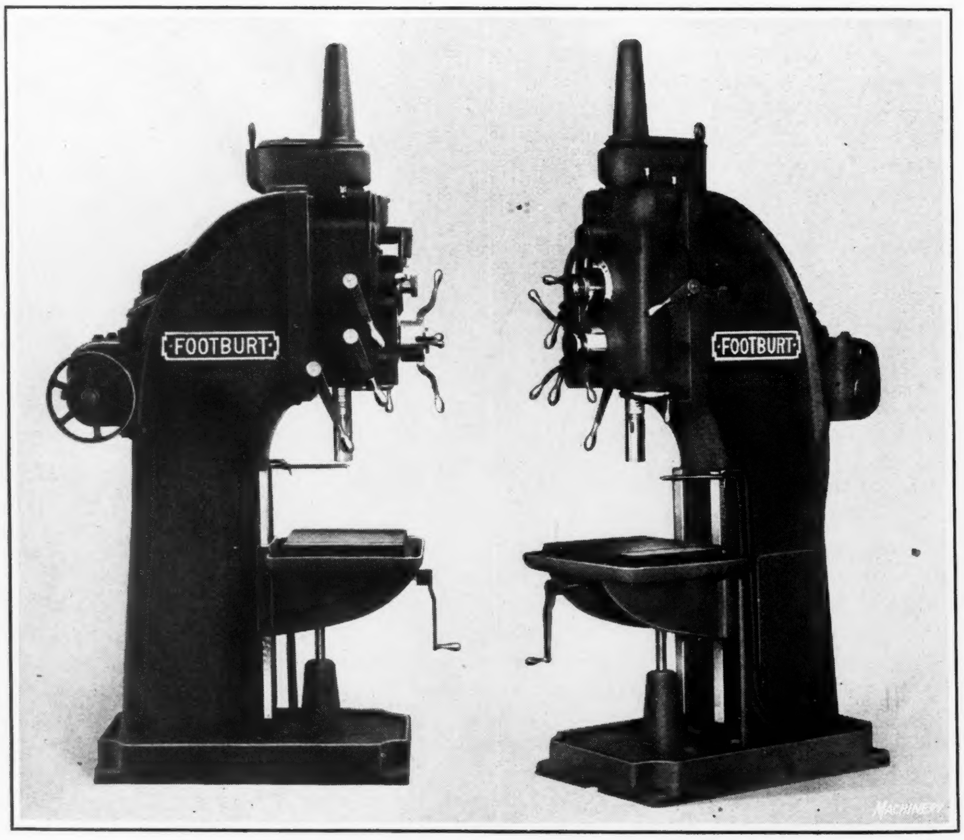
A machine for rapidly slitting automobile piston-rings of the step-cut type, splitting babbitt-lined bearings for automobile crankshafts, milling slots and keyways, and similar operations has been developed by the Superior Machine & Engineering Co., 451-457 E. Fort St., Detroit, Mich. The machine has a single-pulley drive, which is engaged and disengaged by operating the clutch lever. On the driving pulley shaft is mounted a change pulley, from which power is transmitted by belt to a pulley on the lower spindle and then through spiral gears to the upper spindle. The spiral gears are hardened and run in oil. The number of teeth on the two gears of a pair are prime to each other so as to insure a uniform distribution of wear. The spindles are made of high-carbon steel and run in oiled bronze bearings.

The two spindle heads are adjustable and can be clamped in any position on the column without disturbing the gibs. The vertical positioning of the work relative to the lower spindle is done by raising or lowering the knee. This member can be clamped in any position on the column. In making a set-up, the upper spindle head is adjusted relative to the lower one, after which both heads are clamped to the column. Graduated dials are provided on all adjusting screws for securing accurate settings. The saddle of the table can be adjusted toward and away from the column by means of a screw, while the table is traversed past the spindles by operating the hand-feed lever seen in the illustration. The machine can also be driven by a 1½-horsepower motor which may be mounted on a bracket fastened to the base of the machine. This milling machine weighs approximately 900 pounds.

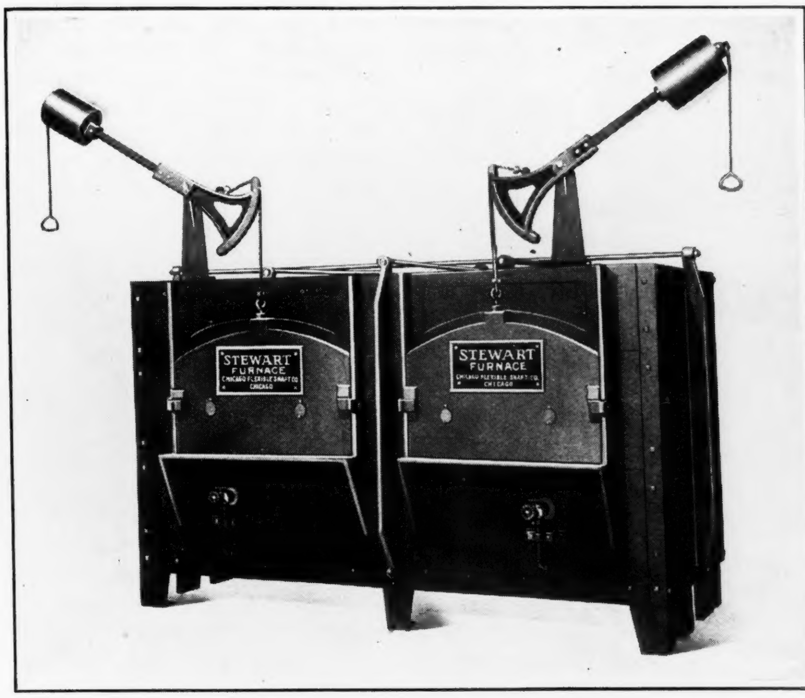
FOOTE-BURT HIGH-DUTY DRILLING MACHINE

Simplicity of construction and operation has been the aim of the Foote-Burt Co., Cleveland, Ohio, in redesigning the No. 23 high-duty drilling machine shown in the accompanying illustration. This machine has a capacity for drilling a hole 1½ inches in diameter through solid steel. Practically all operating members are contained in the head, which can be readily dismantled, should trouble of any nature be experienced, and carried by a crane to a convenient place for repairs. The head is bolted on the vertical face of the heavy box-section upright to bring the bolts into shear. The upright, base, and jack-screw support are cast integral to insure rigidity. Convenient control is provided, all operating levers being located at the front of the head. The single screw of the table permits a 12-inch vertical movement of this member without the necessity of providing a hole in the floor for the screw.

The machine is driven through a single pulley, from which power is transmitted to the driving members through a friction clutch. Nine spindle speeds, ranging from 75 to 610 revolutions per minute, and three feeds, of 0.006, 0.012, and 0.026 inch, respectively, are instantly available through sliding change-gears. Helical gears transmit power to the spindle which has a double-rack feed that eliminates side friction on the sleeve. Either Hyatt or taper roller bearings are supplied in all driving shaft bearings, and ball bearings take the thrust of the spindle. The speed change-gears run in an



No. 23 High-duty Drilling Machine redesigned by the Foote-Burt Co.



Double-chamber Semi-muffle Heat-treating Furnace recently brought out by the Chicago Flexible Shaft Co.

oil bath, while the feed gears are lubricated by a splash oiling system. The upper driving helical gears and their bearings are packed in grease and covered by a cap large enough to contain several months' supply of grease. Some of the principal specifications of the machine are as follows: Distance from center of spindle to face of column, 10 inches; maximum distance from nose of spindle to top of table, 28⅝ inches; length of power feed, 12 inches; taper of spindle socket, Morse No. 4; working surface of table, 20 by 16 inches; and approximate weight of machine, 2700 pounds.

WODACK PORTABLE ELECTRIC DRILL AND GRINDER

A portable electric drill on which two separate speeds may be obtained, which adapt the equipment for grinding operations in addition to drilling, has been brought out by the Wodack Electric Tool Corporation, 23-27 S. Jefferson St., Chicago, Ill. This equipment greatly resembles the drill illustrated in January, 1921, MACHINERY. It has a drilling capacity of from ⅛ to ⅝ inch in steel, and is supplied with a 6- by ¾-inch wheel for grinding operations. The slow speed is intended for use in drilling, and the high speed for grinding. The motor is of ½ horsepower and is of the universal type, operating on either alternating or direct current of the same voltage. It is controlled by a quick make-and-break switch in the handle. This combination drill and grinder weighs about 18 pounds.

STEWART HEAT-TREATING FURNACES AND OIL-PUMPING SYSTEM

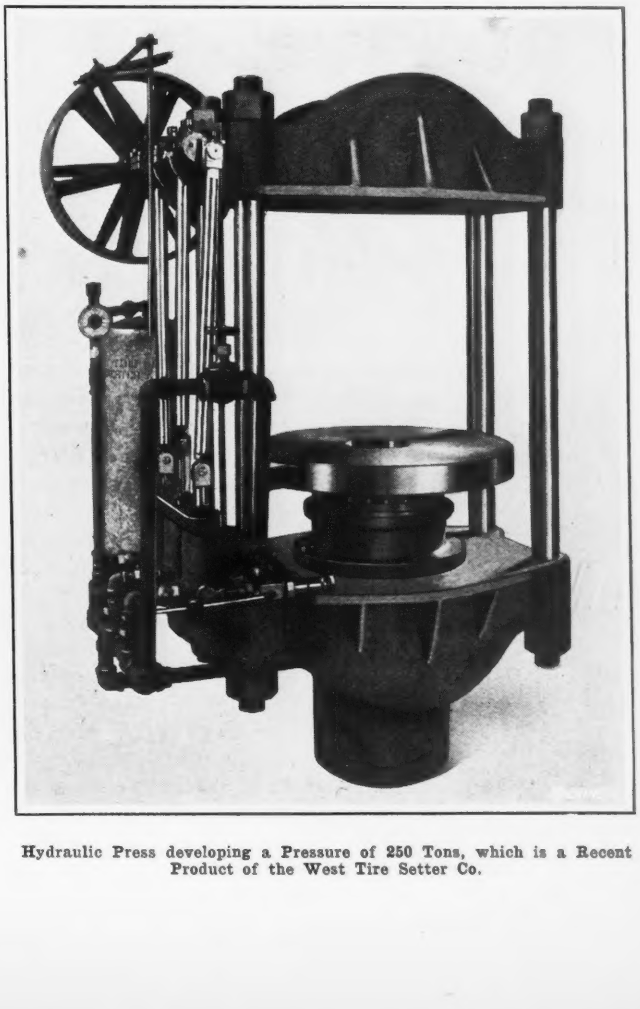
The Stewart double-chamber, semi-muffle heat-treating furnace here illustrated has been added to the line of heat-treating equipment lately developed by the Chicago Flexible Shaft Co., 1154 South Central Ave., Chicago, Ill. Both chambers of this furnace are individually controlled, enabling different operations to be carried on simultaneously. For instance, it is possible to carburize or anneal work in one chamber and at the same time reheat or preheat work in the second chamber. The furnace is underfired, combustion taking place under the floor and the products of combustion passing up along both walls to the arch and then down on the work. Either gas or oil may be used for fuel, or the furnace may be fitted up with combination gas and oil burners. A line of furnaces is also built in which the casing is made of sheet steel instead of cast iron.

Another recent development of this company is an oil-pumping system, which delivers fuel oil at a uniform pressure and free from foreign matter, the latter being removed from the oil by strainers. Spring-load relief valves prevent injury to the system in case the discharge should become closed. These valves also furnish variations in the operating pressure. A pressure dome dampens pulsations in the pump, and serves as a settling chamber in which the water and sediment settle before the oil is delivered to the burners. Gages provide easy readings of the pressure on the oil. This pumping system is regularly made with a capacity for delivering 100 gallons of oil per hour, but special sizes can also be built.

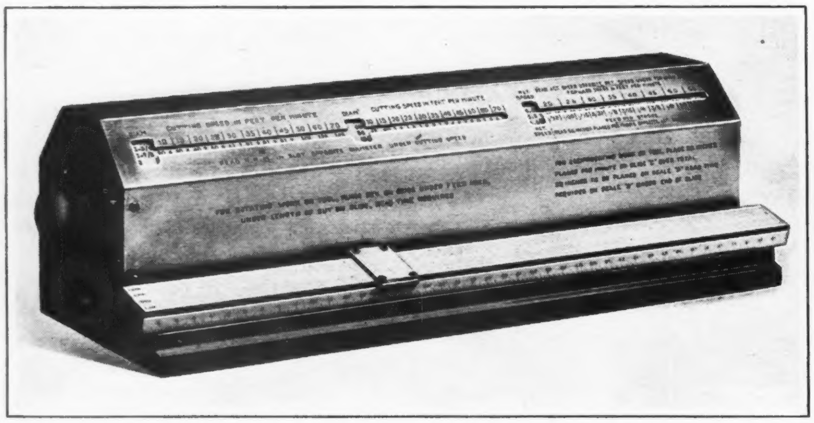
WEST HYDRAULIC PRESS

The 250-ton hydraulic press shown in the accompanying illustration is intended primarily for pressing solid rubber truck tires on or off wheels, but it is also adapted for a variety of other uses. This machine is a recent development of the West Tire Setter Co., Rochester, N. Y. The frame and top platen are steel castings. The ram area is sufficient to produce the required tonnage with the comparatively low initial pressure of 2000 pounds per square inch. The pump is of the three-plunger type with an automatic cut-out for the larger plunger. It is equipped with a 2-inch low-pressure plunger for filling the pipes and cylinder quickly.

When a pressure of approximately 200 pounds per square inch has been obtained, the larger plunger is automatically cut out by a special by-pass valve, leaving the two smaller plungers in operation for obtaining the higher pressure re-



Hydraulic Press developing a Pressure of 250 Tons, which is a Recent Product of the West Tire Setter Co.



Instrument for calculating Operation Time, which has been placed on the Market by the Simplex Calculator Co.

quired for the maximum tonnage. The pressure is applied or released by closing or opening, respectively, a globe valve located in the by-pass piping taken out of the main-pressure pipe. When this valve is opened, the oil or water used as the medium of pressure is returned to the supply tank instead of being delivered to the cylinder of the machine for applying pressure to the ram.

The tank is of the enclosed type, and when desired a compressed air line can be connected to the top of the tank to furnish means of forcing the oil or water quickly into the cylinder to move the ram up to the point where high pressure is required. In cases where air pressure is used for this purpose, the pump furnished has all high-pressure plungers instead of being of the type previously mentioned. A safety valve prevents overstraining of the press when it is run by a careless operator. The bottom platen is 42 inches in diameter, and the maximum distance between the top and bottom platens is 37 inches. The ram has a stroke of 33 inches.

SIMPLEX MACHINE TIME CALCULATOR

A calculator intended for use in computing the time required for operations performed with machine tools, and which is applicable to either rotating or reciprocating work or tools is shown in the accompanying illustration. This instrument is a recent product of the Simplex Calculator Co., Box 184, York, Pa. It consists of a cylinder enclosed by an aluminum case, and a slide-rule of special design attached to an extension of the base. For use in connection with rotating work or tools on such machines as lathes, boring mills, and drilling or milling machines, the cylinder has tables giving the number of revolutions per minute made by work or tools of diameters from 1/4 inch to 10 feet, at all ordinary cutting speeds. The range of speeds is shown above the slot at the left-hand end of the case.

The number of revolutions per minute made by a given piece of work is read in the slot opposite its diameter and directly under the cutting speed selected. This number is then transferred to the slide-rule which has four scales marked Feed, R.P.M., Length, and Time. The number found on the cylinder is located on the R.P.M. scale on the slide, the slide then being moved until the number of revolutions is brought directly under the number on the feed scale corresponding to the feed of the work in inches per minute. The runner is then moved along the length scale to the number representing the length of the cut. Directly under this number on the time scale is found the time in minutes required for the operation. All such problems require but one setting of the cylinder and one movement of the slide and runner.

In connection with planers, shapers, slotters, or other machines having reciprocating tools or work, the procedure is quite similar. The number of square inches planed per minute at various forward and return rates of speeds and different feeds are read on the cylinder through the slot at the right-hand end of the case. After determining the total number of square inches of surface to be planed, either mentally or by the use of the rule, it only remains to divide this number by the number of square inches planed per minute. With one setting of the slide on the rule, the time required for the operation may be read on the time scale under the end of the slide. This instrument was designed primarily for rate setters, estimators, and others whose duties require a study of machine operations. It is about 16 inches long and weighs approximately 3 pounds.

DAVENPORT SLOTTING ATTACHMENT

The slotting of screw heads may now be readily accomplished on the five-spindle automatic screw machine built by the Davenport Machine Tool Co., Inc., 167 Ames St., Rochester, N. Y., by the use of a recently designed attachment. Fig. 1 shows the head containing the saw by means of which the screws are slotted, this unit being mounted on the machine directly above its revolving head. The saw is driven by pulley *A* through the regular change-gears of the machine, thus providing for a number of different speeds. The saw head is covered by a guard, which has been removed in the illustration.

The unit shown in Fig. 2 is mounted on a bracket bolted to the machine. It receives each screw as it is cut off the stock, and carries it through the slotting operation. Turret *B* has three plungers *C* held in bosses spaced equidistantly around a circle struck from the center of the turret. These plungers are fitted at their front end with a bushing that fits the screw to be slotted, while the rear end is machined with a T-head. On support *D* are mounted three sliding spindles which are yoked together by spider *E*, the spindles thus being slid forward in unison by a motion imparted to the spider by a cam-lever. Two of the spindles have a head *F*

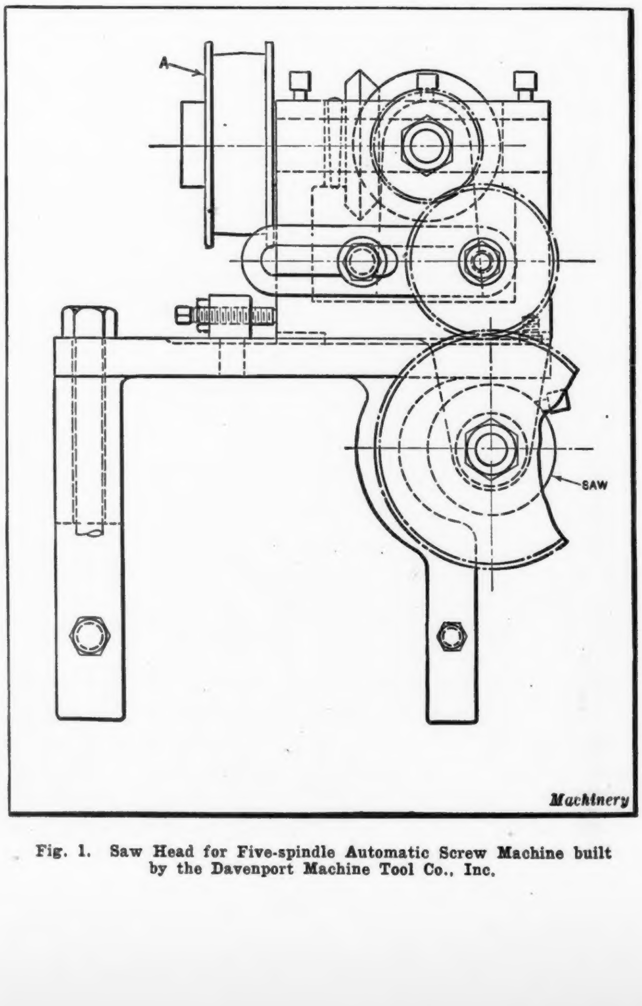


Fig. 1. Saw Head for Five-spindle Automatic Screw Machine built by the Davenport Machine Tool Co., Inc.

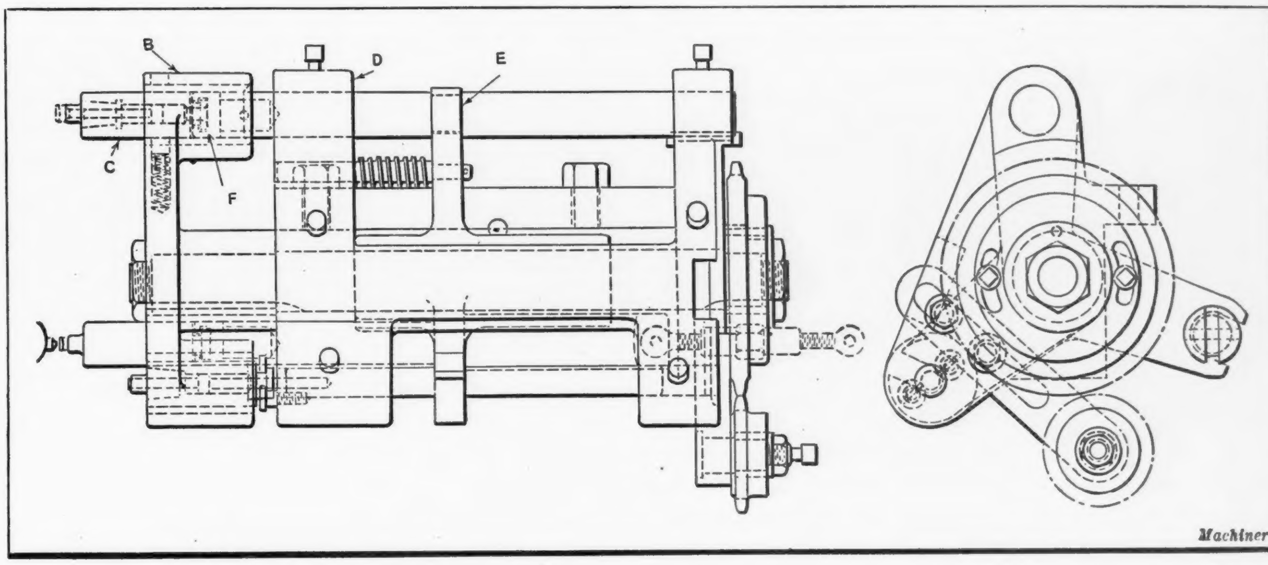


Fig. 2. Attachment employed in Connection with the Saw Head shown in Fig. 1 for slotting the Heads of Screws

provided with a T-slot that fits the rear end of the plungers, while the third spindle carries an ejector that is forced through the plungers as they are indexed to this position.

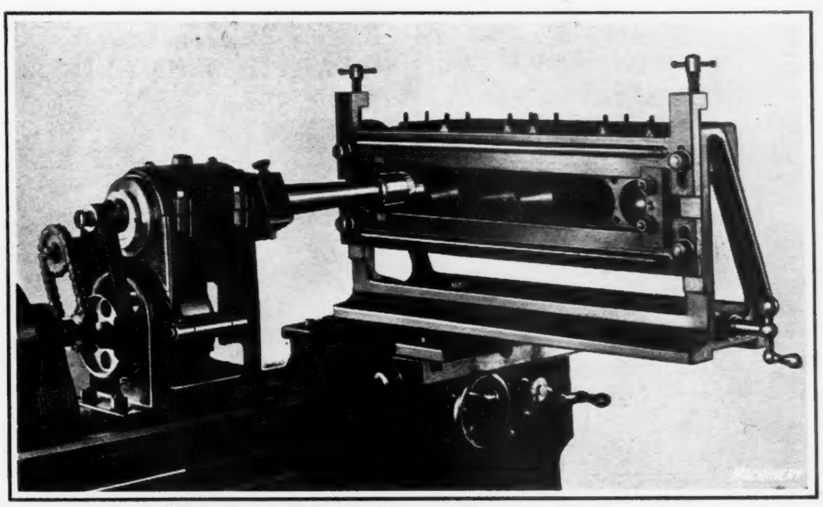
The turret is indexed one-third of a revolution for each revolution of the crankshaft of the machine. After each indexing, two of the plungers are forced forward by the sliding spindles, while the ejector slides through the other plunger, as previously mentioned, one of the plungers receiving a cut-off screw. After the two plungers have been drawn back by the spindles to a stop, the turret is again indexed one-third of a revolution. Then, as the plungers are advanced again, the screw previously received is brought into contact with the saw and slotted, while a second screw is received by the plunger bushing indexed into the loading position.

At the next forward movement of the spindles, which occurs after another indexing of the turret, the slotted screw is ejected, the second screw is slotted, and a third screw is received by the remaining plunger. This cycle is continuous. When the work does not require it, the attachment can be quickly dismantled after removing two bolts. By making slight modifications, the attachment can also be used for milling, cross-drilling and burring.

"ELTECO" LATHE CYLINDER-GRINDING ATTACHMENT

To enable small machine shops and garages to equip themselves at slight expense for regrinding automobile cylinders, the Liberty Tool Co., 1080 Springfield Ave., Irvington, N. J., has brought out the attachment illustrated, which is applicable to lathes of 14-inch and larger swing. The driving motor is mounted beneath the wheel-spindle in a housing placed on the bed close to the headstock. The motor is of ½ horsepower and is intended to be driven from an ordinary lamp socket. The cylinder block is held on an angle-plate mounted on the regular lathe carriage, and is fed to the grinding wheel by means of the carriage feed, the feed gearing being driven through sprockets and a silent chain by the motor of the attachment. This arrangement permits all the different feeds of the machine to be utilized. The wheel-spindle is driven at the rate of 5600 revolutions per minute.

The eccentric throw of the wheel from dead center is adjustable by a hand-screw graduated to 0.0005 inch. The holder will accommodate the largest-size six-cylinder block, having an inside length of 33 inches. Cross movements of the holder are obtained through a screw, and the holder may be raised or lowered by means of two vertical screws. The attachment weighs about 500 pounds.

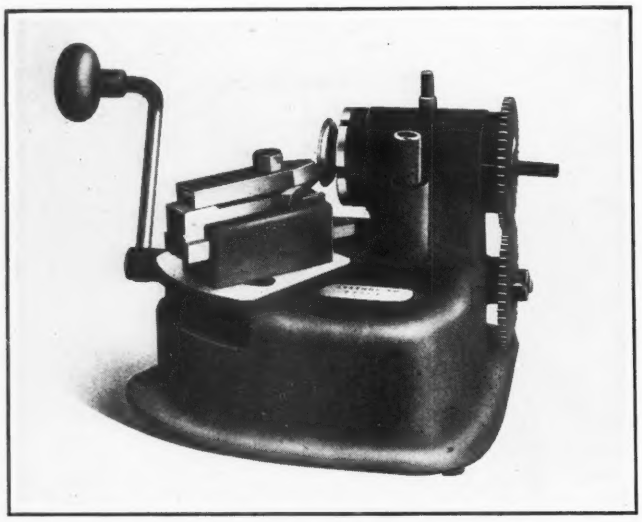


Lathe Attachment made by the Liberty Tool Co., for regrinding Automobile Cylinders

STEINER VALVE FACER

A hand-operated bench machine for accurately and quickly refacing valves of internal combustion engines has been placed on the market by Steiner Bros., Lima, Ohio. It is called by the manufacturers the "Peerless valve lathe." The mechanism for holding the valve consists of two collars having three cam surfaces on the inside which, when the collars are turned, operate three pins at each end of the hollow spindle through which the valve stem is inserted and cause these pins to advance toward the center of the spindle and bear on the stem. The latter is inserted from the left-hand end of the spindle, the hole of which is sufficiently large to accommodate the fillet, which is quite pronounced on some valves. The cams are then turned by applying a spanner wrench to the slots on their periphery. A nut provides for locking one cam, while the gear that rotates the spindle also serves as a locking device for the second cam. The spindle is driven through this gear by revolving the crank on the driving shaft.

A pin at the top of the machine functions both as an oil plug and a locking device for the spindle, the locking being accomplished by inserting the long end of the pin through holes in the body and the spindle. It is necessary to lock the spindle when manipulating the cams and locknut. The tool is fed



"Peerless" Valve Facing Machine made by Steiner Bros.

uniformly through a worm on the driving shaft which meshes with a worm-wheel on a vertical shaft. Near the lower end of this shaft and immediately above the worm-wheel a pinion engages a segment mounted on another vertical shaft, at the top of which is fastened a second segment that operates a rack attached to the tool carrier. When positioning the tool, the worm-wheel is disengaged from the driving shaft by depressing the knurled knob at the top of the machine. Provision is made for quickly returning the tool to the starting position when it is found that more than one cut is necessary on a valve face. The uniform rate of feeding the tool is said to produce a satisfactory face and reduce grinding-in to the minimum.

TAYLOR & FENN CIRCULAR MILLING ATTACHMENT

To adapt the high-speed vertical milling machine of its manufacture to circular milling operations, the Taylor & Fenn Co., Hartford, Conn., has designed the attachment shown in the accompanying illustration. This attachment is mounted on the regular table of the machine and driven from the telescopic shaft which furnishes the longitudinal table power-feed. By this means the thirty-three different

Circular Milling Attachment intended for Use on the Vertical Milling Machine built by the Taylor & Fenn Co.

feeds of the machine may be quickly obtained for the circular table, and in addition the circular feed may be varied by transposing two gears in the lower driving bracket. This provides a wide range of feeds which will be found especially useful in continuous milling operations. It is possible to drive both the longitudinal and circular tables simultaneously, this being of advantage on some classes of work. Some of the principal specifications of this attachment are as follows: Diameter of working surface, 10½ inches; maximum height from nose of machine spindle to table, 9 inches; ratio of table revolution to turning of handle, 40 to 1; and weight, about 110 pounds.

HOFFMAN DRAWING TABLE

A line of drawing tables in which the supporting members are tubular, as shown in the accompanying illustration, has been developed by the Hoffman Drawing Stand Co., 189 N. Water St., Rochester, N. Y. This design provides a light construction without sacrificing strength or rigidity. The table can be quickly raised to any height from the floor up

Drawing Table placed on the Market by the Hoffman Drawing Stand Co.

to 44 inches by revolving the handwheel on the vertical screw; and, in addition, the table can be tilted from the horizontal plane to almost a vertical position. Large corks inserted in the feet of the stand prevent the marring of polished floors or slipping of the stand. The drawer tray may be attached to either the left- or right-hand vertical supporting rod and held in any position on the rod.

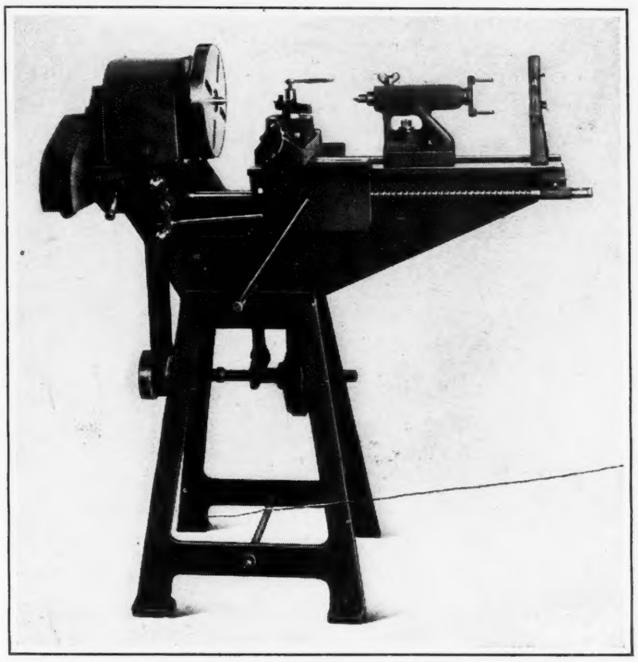
ARTISAN SMALL-SIZE GAP LATHE

An 11-inch gap lathe having a maximum distance of 24 inches between centers, which may be used as a portable equipment, has recently been brought out by the Artisan Mfg. Co., Cincinnati, Ohio. From the illustration it will be noted that a quick-change feed-box is furnished, the feed-box containing a clutch for engaging and disengaging the feed. This clutch is operated by the lever below the double crank-handle. The crank-handle is used for traversing the carriage by hand when working on short jobs with the carriage close to the faceplate. The shelf below the gap serves as a support for the carriage when it is run over the gap, an adjustable plug on the left end of the apron bearing upon the planed surface of the shelf to withstand the downward pressure.

When the carriage is required near the tailstock end of the bed the double crank-handle may be put on the right-

hand end of the lead-screw where the screw extends from a bearing. The feed-box offers a wide range of feeds which enable all standard threads to be cut from 8 to 224 per inch, inclusive, and also 11½ pipe threads per inch. Reverse gears providing for the cutting of both right- and left-hand threads are contained within the swinging quadrant at the end of the headstock. This quadrant also contains compound gears for cone gears within the feed-box. A sliding tumbler lever engages any of the cone gears, while a direct-reading index-plate on top of the feed-box designates the proper position of this lever for a desired feed.

The cross-slide may be swiveled for angular turning, and when set for straight facing, taper dowel-pins serve to locate it in the correct position. The countershaft is mounted in self-aligning bronze bearings secured to the rear legs, and may be driven direct from a lineshaft through its friction pulley or by a motor mounted on the bed. The friction pulley is of the cone type having a spring that keeps it in engagement. A vertical rod at the rear of the machine has a fork which engages a flange of this friction clutch. This rod is



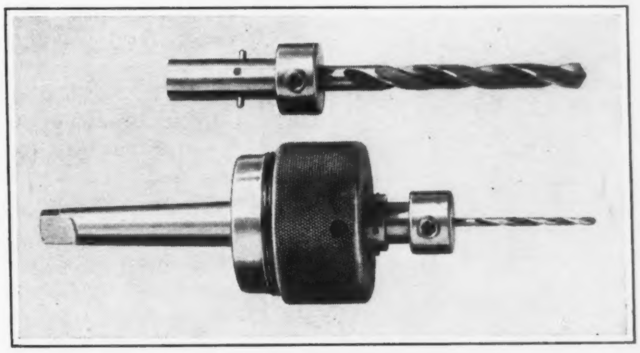
Eleven-inch Gap Lathe produced by the Artisan Mfg. Co.

operated by a shaft extending through the bed which has a lever at the front end. When this lever is pushed downward, the friction cone is withdrawn from the pulley and the fork that engages the flange of the disk serves as a brake to stop the countershaft instantly.

The drive from the countershaft to the headstock is through three-step cone pulleys. The cone pulley on the headstock is geared to the main spindle and in combination with a sliding back-gear gives six changes of speed in geometrical progression. A motor of ½ horsepower is recommended for driving this lathe, and the current may be supplied from an ordinary light socket. The swing of this machine at the gap is 16 inches, and over the carriage 8¾ inches.

"SAVE-ALL" SAFETY DRILL AND TAP CHUCK

A positive safety chuck for straight-shank drills, taps, reamers, counterbores, etc., which is intended for operations in which the feed is by hand, has just been placed on the market by the Save-All Tool Co., 59 River St., Waltham, Mass. It has been designed with the purpose in mind of eliminating the breakage of small tools. The safety device by means of which such breakages are prevented consists of two friction members and a soft steel driving pin, which is



Safety Chuck for Hand-fed Tools, made by the Save-All Tool Co.

sheared when the tool is overloaded. The tool is held in a hardened collet by means of a "Bristo" hollow safety set-screw which bears on a flat on the tool shank.

The soft steel driving pin is inserted through the collet and a hardened male friction member which is adjusted by the knurled nut on the outside of the chuck body. The female friction member is keyed to the body, the nut bearing on it and thus preventing it from tightening or loosening when the tool is run forward or backward. When the resistance to the tool becomes too great so that it sticks, the pin is sheared. There are three sizes of pin holes in the standard collet, the smaller ones being used with high-speed drills. The pin is held in place by a spring plunger.

MARQUETTE SPRING CUSHION FOR PUNCH PRESSES

With the view of eliminating wrinkles when drawing shells on punch presses and of reducing the pressure on the draw-ring, the Marquette Tool & Mfg. Co., 321 W. Ohio St., Chicago, Ill., has brought out an even-pressure spring cushion that differs somewhat in design from the spring cushion developed for the same purpose, which was described in October, 1921, MACHINERY. The new type is designed primarily for use on small and medium-size presses and under conditions requiring that a device of this kind be quickly attachable and detachable. Fig. 1 shows the cushion applied to a press. It is unnecessary to provide holes on the machine for attaching it, the cushion being simply held in place by screwing the upper threaded end of the suspension bolt, clearly seen in Fig. 2, into a tapped hole in the bottom of the die or bolster plate.

This suspension bolt extends through a sleeve having teeth cut on its outer surface near the upper end which are engaged on opposite sides by the teeth of two compensating cams. These cams swivel about their bearings when the draw-pins of the die are forced downward, the draw-pins

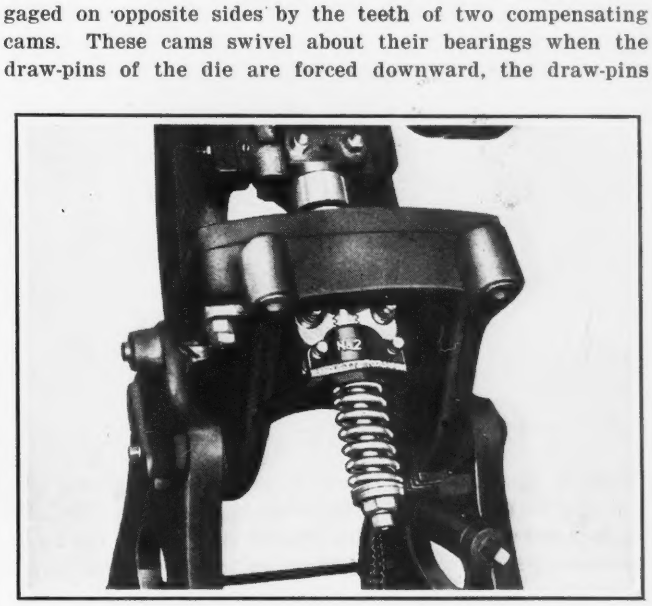


Fig. 1. Application of the Even-pressure Spring Cushion introduced to the Trade by the Marquette Tool & Mfg. Co.

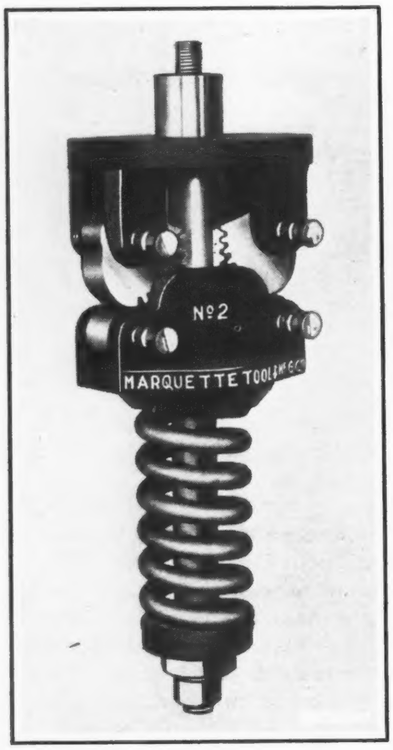


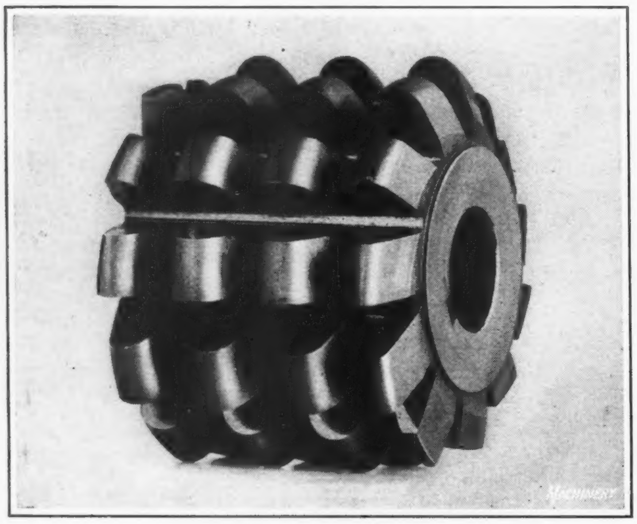
Fig. 2. Even-pressure Spring Cushion

resting on a plate and spacer block placed on top of the cam housing. Another housing directly below the cam housing has two rollers that contact with the cams. The swiveling of the cams on their bearings causes a vertical movement of the rollers and so controls the compression of the spring in an operation, this compression, of course, being less than if the spring was not provided with compensating members.

When pressure is released from the draw-ring, the friction between the rollers and cams caused by the spring forces the cams to return to their original positions. The initial pressure on the spring may be regulated by means of an adjustable nut placed on the lower end of the sleeve. Grease cups provide for adequate lubrication of the roller and cam bearings. It is said that presses equipped with this die cushion will produce in one operation work generally performed in two, and that the wear on the dies is less severe.

DIAMOND SPROCKET-TOOTH HOBS

The accompanying illustration shows a hob of a set manufactured by the Diamond Chain & Mfg. Co., Indianapolis, Ind., each of which is suitable for cutting any number of sprocket teeth of a given pitch and roller diameter. Thus each hob will do work that ordinarily requires from six to nine cutters. In addition, there is the advantage of em-



Hob manufactured by the Diamond Chain & Mfg. Co. for Cutting Sprocket Teeth

ploying a hobbing machine which permits high production rates and convenient and accurate indexing. These hobs are designed to cut sprocket teeth in conformity with the specifications for the "American Standard" sprocket-tooth form, which has been approved by manufacturers of roller transmission chains, the Society of Automotive Engineers, the American Society of Mechanical Engineers, and the American Gear Manufacturers' Association. This tooth form is particularly adapted for production by hobbing. Its space angle gradually decreases as the number of teeth increases, while its tooth angle, and hence its pressure angle, gradually increases. The generating action of a hob tends to produce these changes although not at the same rate. The pitch of each hob is greater than the circular pitch of the sprocket for all above a certain number of teeth, and less than the circular pitch for all under that number.

NIAGARA COMPOUND-SEAM CLOSER

Air-tight side seams can be made on such articles as drums for calcium carbide and cans for calcium chloride by employing the seam-closing machine developed by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., which is illustrated in Fig. 1. The seam produced may be filled with a sealing compound, although the seam as closed by the machine is practically air-tight. Offsets

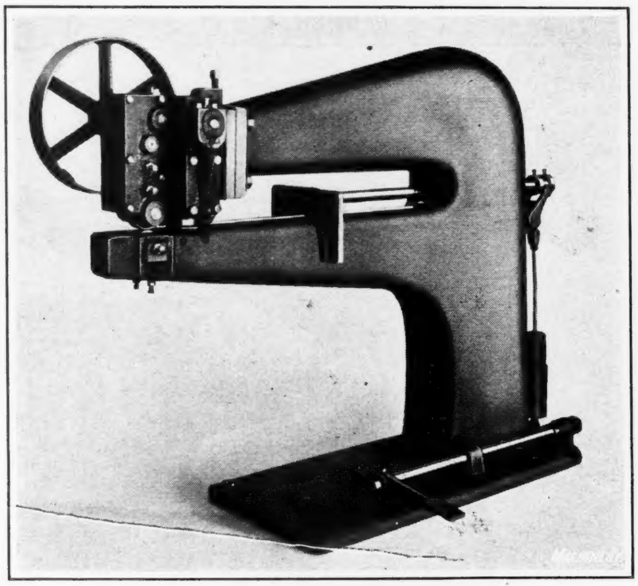


Fig. 1. Seam-closing Machine built by Niagara Machine & Tool Works

are first formed on the ends of the sheet to be joined, as shown at *A* and *B* in Fig. 2, after which the sheet is rolled to a cylindrical shape and placed over the horn of the machine with the offsets lying on the guide piece set into the top of the horn.

The machine runs continuously, and therefore does not require tight and loose pulleys or a clutch, the pulley being run at the speed of 100 revolutions per minute. The treadle at the front of the machine is connected to a sliding member, and by depressing the treadle the work is moved forward along the horn and fed between the first set of rolls which squeeze the seam together at the bottom. After these rolls take hold of the work, the latter is automatically fed through the machine, the second set of rolls flattening and thus closing in one operation the double-lock seam shown at *C*. The maximum length of work that can be handled is 42 inches, and the minimum diameter for this length is 13½ inches. The machine has a capacity for No. 22 gage soft steel, and weighs approximately 2700 pounds.

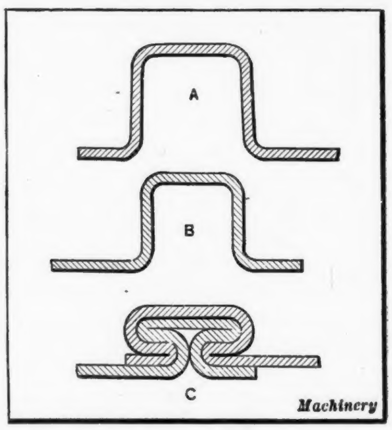
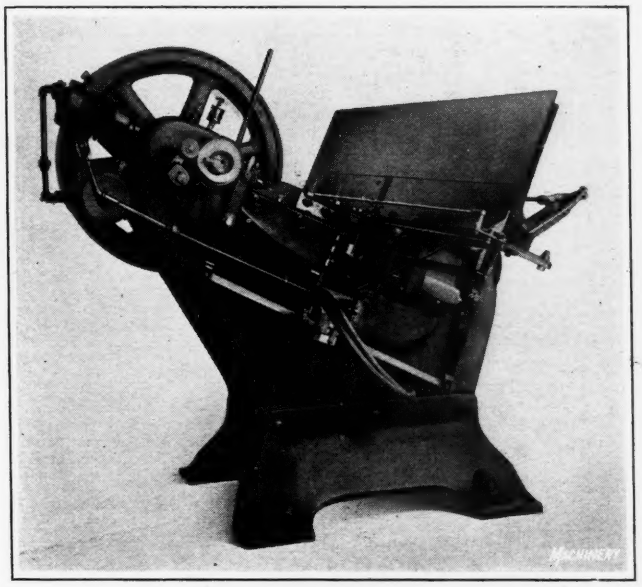


Fig. 2. Three Stages in the Seam-closing Operation

ADRIANCE STAGGER-FEED PRESS

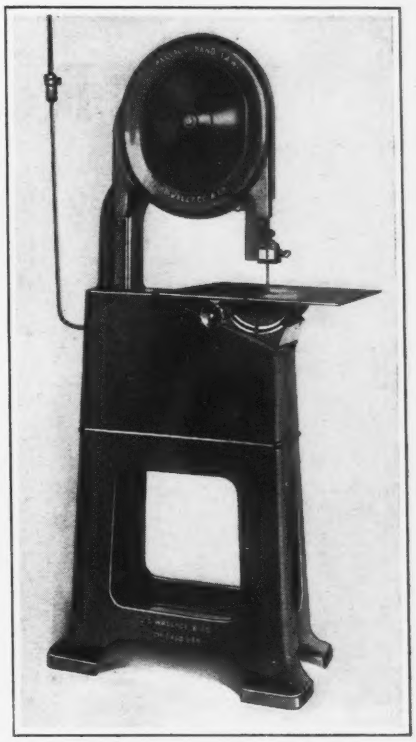
An automatic punch press on which the punch operates continuously and cuts blanks in a staggered relation to one another, leaving a mere thread of metal between the holes is shown in the accompanying illustration. This machine has been recently developed by the Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y., and is especially suitable for the production of such parts as can tops and bottoms and other small shells. The sheet stock is held in a carrier which travels in either direction past the reciprocating punch. It is not necessary for the carrier to be returned to the starting point after punching a row of blanks, because the moment the end of a row has been reached the action of the carrier is automatically reversed and the next row may be punched as the carrier returns to the starting point. After the last blank has been punched from a sheet the carrier stops automatically. It is thus possible for an operator to run several presses at one time. His safety is assured, because at no time do his fingers come near the die. The scrap stock is ejected automatically. The machine will cut blanks from 1 to 4 inches in diameter and has produced them at the rate of 100 per minute.



Automatic Stagger-feed Punch Press placed on the Market by the Adriance Machine Works, Inc.

WALLACE BENCH BAND SAW

A machine primarily of interest to patternmakers is the 16-inch portable band saw illustrated, which is a recent development of J. D. Wallace & Co., 1421 W. Jackson Blvd., Chicago, Ill. This saw is driven by an enclosed motor built into the machine and direct-connected to the lower saw wheel by a fabroil gear and a steel pinion, both of which run in oil. The motor is of ½ horsepower, and runs at a speed of 1750 revolutions per minute, operating on current obtained from a lighting circuit. The machine is equipped with steel disk wheels. The table is a ground plate mounted on a rocker bearing which is adjustable from 45 degrees in one direction to 5 degrees in the opposite direction. An indicator shows the angle at which the table is tilted. All adjustments are obtained by means of handwheels or thumb-screws. The saw blades are made from a special steel, and are operated at a speed of 3150 feet per minute. The table has a surface of 19 by 21 inches, and is located 42 inches above the floor. The height of the machine is about 6 feet.



Wallace Sixteen-inch Band Saw

MONITOR "THERMALOAD" MOTOR STARTER

A thermal-limit starter known as the "Thermaload," which is intended for controlling the operation of alternating-current, single-, two-, or three-phase motors of from ¼ to 10 horsepower, has been placed on the market by the Monitor Controller Co., Baltimore, Md. This starter (see Fig. 1) is peculiarly adapted to machine tool application in that a number of control stations, which are of the push-button type, may be mounted in several convenient locations on a machine so that the operator can instantly stop the machine when he desires. If the load on a cutting tool becomes too great, the appliance immediately stops the motor. It allows the motor to exert six or seven times its normal power for a limited period, but at the same

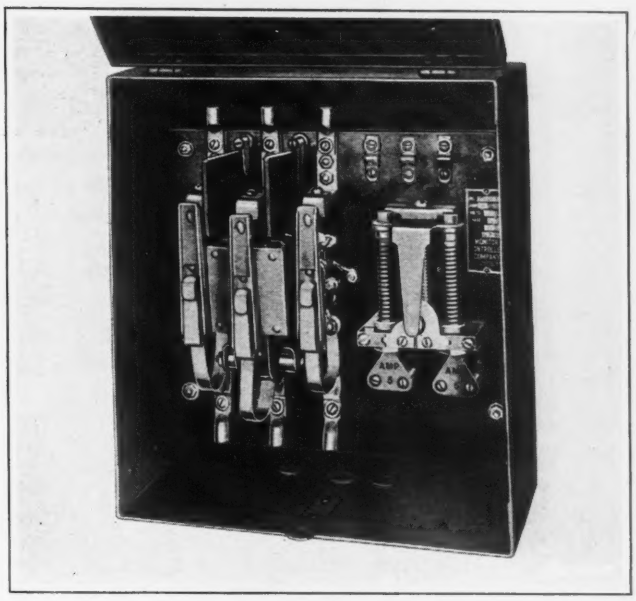


Fig. 1. "Thermaload" Starter for Induction Motors made by the Monitor Controller Co.

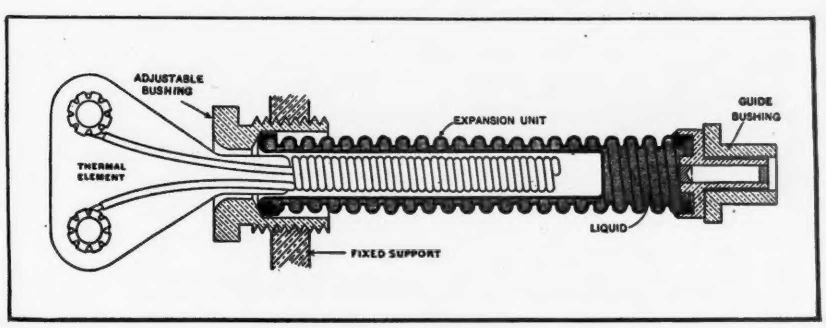


Fig. 2. Sectional View of the Thermal Unit in the Monitor Starter

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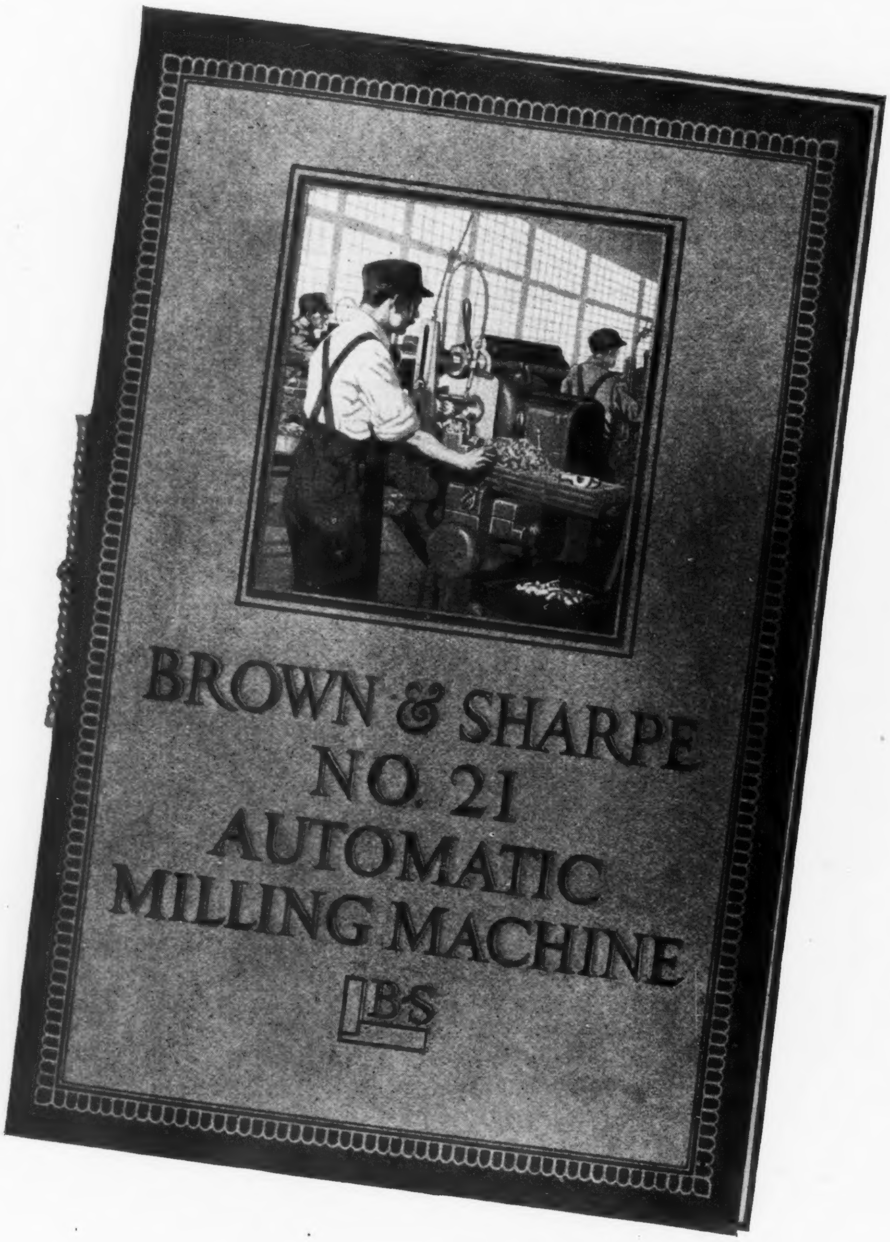

This new booklet featuring the Brown & Sharpe No. 21 Automatic Milling Machine is full of interesting information and detailed production figures. We want every manufacturer of duplicate parts in quantity and all others interested in production milling to have a copy.

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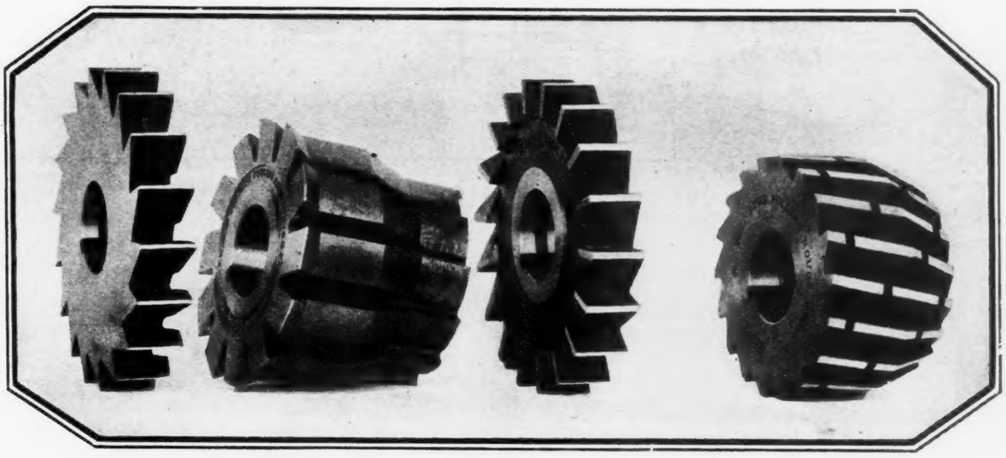
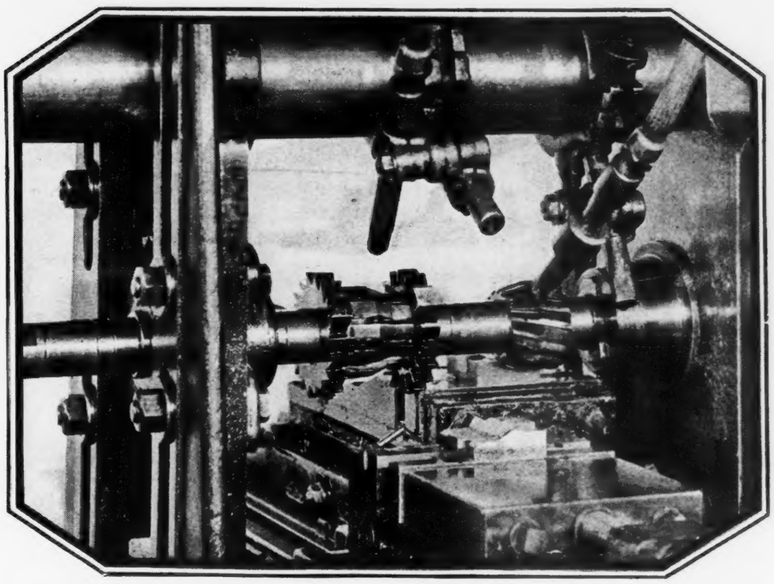


Formed Cutters used in Roughing and Finishing a Small Machine Part on a Brown & Sharpe No. 21 Automatic Milling Machine.

BROWN & SHARPE FORMED MILLING CUTTERS

Strong, accurate, durable—Brown & Sharpe Special Formed Milling Cutters adequately meet the severe demands and exacting requirements found in the quantity production of duplicate parts. They are used with great success on Brown & Sharpe No. 21 Automatic Milling Machines, whose consistent performance gives abundant proof of their strength, accuracy, and durability.



Note the application of the Formed Cutters shown above in Rough Milling top and Finishing top and sides of a Small Machine Part in one operation.

Catalog No. 28 awaits your request.

Wherever Metal is Worked — BROWN & SHARPE CUTTERS.

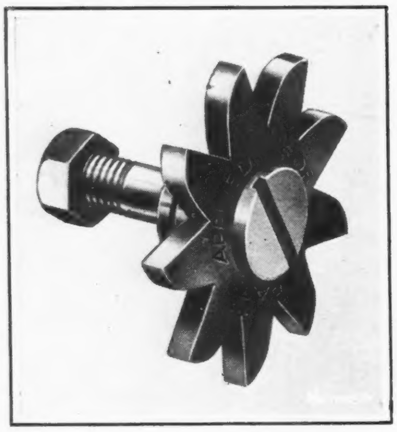
time will protect it from a prolonged overload as small as 25 per cent and from overheating sufficiently to cause injury to insulation. It prevents polyphase motors from running on single-phase current.

The starter consists of a three-pole magnetic contactor and a thermal-limit relay, mounted on a slate panel and enclosed in a metal cabinet which may be locked or sealed and placed in a remote location, as on the ceiling. The thermal-limit relay consists essentially of two units which expand between a fixed support and a hinged contact arm, the latter being arranged in such a way as to multiply the motion of the expansion units several times at the contact. The construction of an expansion unit is shown in Fig. 2. It will be seen that a unit consists of a double-walled tubular receptacle, the inner wall of which is smooth and closed at one end, while the outer wall is corrugated and closed at both ends.

The space enclosed between the two walls is filled with tetrachloride of carbon, a non-corrosive, non-freezing liquid used in fire extinguishers. The thermal element which operates the expansion unit consists of a coil of asbestos-insulated wire attached to a piece of insulating material by means of brass eyelets. These eyelets register with brass binding posts to which they are securely clamped by means of brass screws. The binding posts, in addition to serving as electrical connections to the element, also furnish its support. A relay can be changed from one rating to another by merely inserting the proper elements.

DISSTON SAW-CHIP REMOVING DEVICE

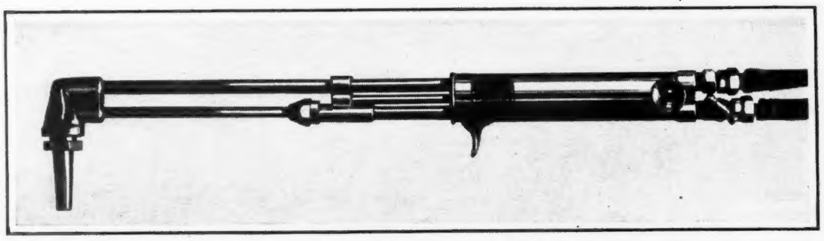
Breakage of the teeth of metal-cutting saws is frequently caused by the clogging action of the chips, which causes a heavy strain to be placed on the teeth. With a view to eliminating such trouble, Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa., has brought out the special wheel illustrated, which has teeth spaced to suit the teeth of the saw with which it is intended to be used. This wheel is attached by means of the stud, to some member adjacent to the saw; it is placed at right angles to one side of the saw in such a position that the teeth of the wheel engage the tops of the saw teeth as the saw revolves and push the chips from these surfaces. As the saw teeth are kept free from chips when this device is used, the saw can be operated at faster speeds and heavier feeds.



Saw-chip Remover made by Henry Disston & Sons, Inc.

DAVIS-BOURNONVILLE CUTTING TORCH

A cutting torch in which two tubes instead of three connect the head with the handle, and in which the preheating gases, which may be oxygen and acetylene or some other combustible gas, are mixed in a chamber between the handle and the head, is a new product of the Davis-Bournonville Co., Jersey City, N. J. This design requires a new style of tip, inasmuch as the mixture of the gases is accomplished before they reach the tip. The tubes are silver-soldered in the head, the latter being a copper forging, which, besides being free from pin holes and similar defects, will withstand higher temperatures than bronze or brass castings.



New Type of Cutting Torch brought out by the Davis-Bournonville Co.

The ratio of the mixed gases is controlled by two needle valves, one of which has a cross-bar handle and the other a knurled disk handle. The cutting-oxygen valve is operated by a finger-lever connected to a linkage so designed as to hold the lever in either the closed or the open position. Thus the operator may cut work without holding his finger on the trigger after the operation has been started, and when he wishes to stop cutting, a reverse pressure on the trigger closes the valve. A spring holds the trigger in the closed position until the trigger is operated again. Provision is made for easily removing the back end of the torch in case it becomes necessary to clean the screen or to remove the oxygen-cutting valve seat.

The tips are made of copper and held in a taper seat by a bushing nut, this construction being identical with that of the Davis-Bournonville standard torch. The tips are made with the cutting-oxygen hole at the center and the preheating holes surrounding it. The number of preheating holes in a tip varies from two to six, depending on the combustible gas used, the manner in which the torch is applied, and the metal being cut. Bent tips are furnished for cutting off rivets. Gases of low calorific value such as butane, hydrogen, carbo-hydrogen and even illuminating gas, may be used, although acetylene is recommended when cost is not the prime consideration and smooth even cutting is required.

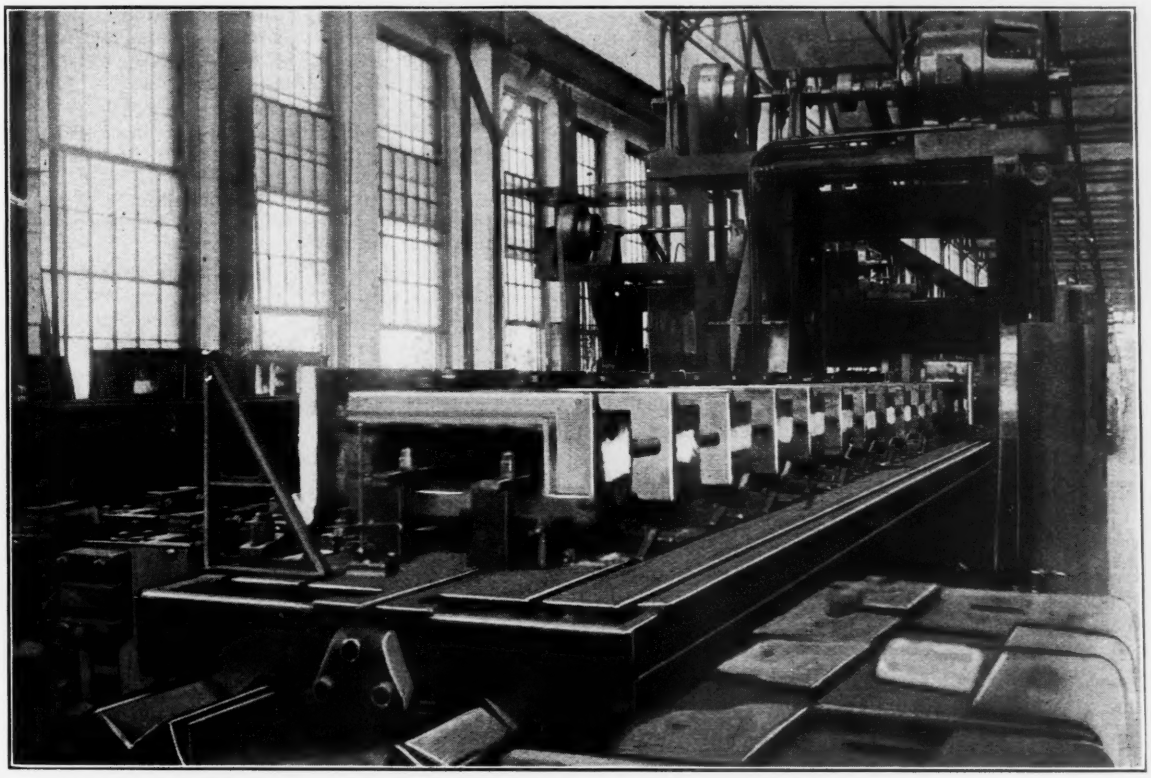
PANGBORN SAND BLAST

A small size sand blast, which can be easily conveyed from place to place about a plant, is a recent addition to the line of sand-blast equipment manufactured by the Pangborn Corporation, Hagerstown, Md. This sand blast has a suction type gun in which the blast action is controlled by a trigger in the handle. Compressed air passing through the air jet creates a vacuum by which the abrasive, either sand or metallic, is brought from the hopper to the gun body, which has a mixing chamber where the air and the abrasive are given a swirling action similar to the movement given a bullet by the rifling of a gun barrel.

Quickly interchangeable nozzles make the equipment suitable for use under a number of conditions. It may be operated at any pressure between 5 and 100 pounds per square inch. The small cabinet set over the hopper of the sand blast in the illustration provides an economical means of cleaning small parts. The sand blast, however, may be used without this cabinet.

Small Sand Blast and Cabinet manufactured by the Pangborn Corporation

Some refinements in Manufacturing
CINCINNATI MILLERS



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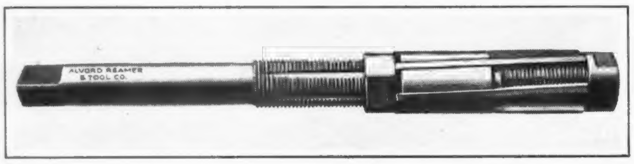
ALVORD HELICAL INSERTED-BLADE REAMER

An adjustable inserted-blade reamer incorporating the unusual feature of having the blades set at an angle so as to produce a shearing cut is a recent product of the Alvord Reamer & Tool Co., Millersburg, Pa. This tool is sold under the trade name of "X-Cel." The purpose of the design is primarily to eliminate chatter in operation. Its construction is similar to the straight-fluted adjustable reamer manufactured by the same company. The body is made of a tough alloy steel and heat-treated on the shank end to withstand rough treatment. The threads that control the adjustment feature are accurately chased and finally checked



"X-Cel" Shear-cut Adjustable Blade Reamer made by the Alvord Reamer & Tool Co.

by a gage. The tapered slots that receive the blades are milled to close limits and at the proper angle to produce the desired shearing effect.

The blades are made of a special steel and accurately ground all over. Both ends of a set of blades are ground to the correct angle for contact with the nuts in one setting on a grinding machine, which also insures that all the blades will be produced to exactly the same length. Thus they are locked securely in their seats when the nuts are tightened. The nuts are made of crucible steel, and are also hardened and ground. This reamer is especially recommended for use with bearing metals, particularly bronze. It produces satisfactory results when employed with split bearings and holes provided with oil-grooves or keyways. The reamer is made in seventeen standard sizes to cover a range of diameters from 15/32 to 4 1/16 inches.

* * *

NEW MACHINERY AND TOOLS NOTES

Worm-gear Drive for Lineshafting: Cleveland Worm and Gear Co., Cleveland, Ohio. An enclosed worm-gear unit for driving lineshafting direct from a motor attached to the ceiling, the armature shaft of the motor being at right-angles to the lineshafting. This driving method permits the use of smaller, higher speed motors. Large ratios of reduction can be obtained.

Buffing and Grinding Machines: Valley Electric Co., 3157 South Kingshighway, St. Louis, Mo. A line of floor-type buffing and grinding machines on which the motor is totally enclosed and its shaft is extended and threaded at both ends for accommodating the buffing and grinding wheels. The motor is mounted on a cast-iron pedestal on the front of which is a safety switch. A pulley on the motor shaft provides for driving an air compressor.

Lathe Chucks: Cushman Chuck Co., Hartford, Conn. An improved line of lathe chucks made in all sizes from 10 to 30 inches. A special feature is the thrust bearings which are made in two parts and completely encircle the screws at a point about midway of their length. The stems of the thrust bearings are driven into round holes in the chuck body and are therefore self-aligning. The bearings hold the screws in place whether the jaws are assembled or not. All parts are finished to gages and are interchangeable.

Automatic Cutting Machine: General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. An automatic cutting machine intended for cutting such metal parts as dies, cams, crankshafts, and drop-forge tools directly from steel plates. The machine has two carriages, one of which is mounted on the other. The upper carriage has on one side an oxy-acetylene cutting torch, and on the opposite side it supports the driving and tracing system. Any movement on the pattern is transmitted directly to the torch. A motor on the top carriage transmits its power through a friction wheel.

PERSONALS

Charles B. Siner has been made treasurer and general manager of the T. C. Dill Machine Co., Philadelphia, Pa.

T. H. Hays has been appointed manager of the Indianapolis office of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

J. J. Wittenburg has been placed in charge of the St. Louis office of the Chicago Flexible Shaft Co., Chicago, Ill. The office is located in the Railway Exchange Building, as it has been heretofore.

L. E. Salom has been appointed district representative for the New York territory of the Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. He will make his headquarters at 50 Church St., New York City.

Kenneth MacNeal, formerly secretary-treasurer of the Jones, MacNeal & Camp Co., Warsaw, Ind., has become president of that concern, succeeding L. E. Jones. Arthur MacNeal has been elected vice-president and treasurer, and D. B. MacNeal assumes the duties of secretary and general sales manager.

H. L. Carpenter, Jr. has been appointed traveling representative in western Pennsylvania for the Ajax Metal Co., Philadelphia, Pa. He has been associated with this company for over twenty years, having had charge of the Pittsburg office and later being connected with the main office in Philadelphia.

L. A. Carter has been made president of the Lehmann Machine Co., St. Louis, Mo. He became connected with this company several years ago, starting as engineer and designer, and advancing to the position of general manager and now to the presidency. He is the designer of the lathes made by this company.

A. E. Hitchner, assistant to the manager of the industrial department, in general charge of the mining and electrochemical industries, of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been placed in charge of the sections formerly handled by W. H. Patterson, who recently resigned to become vice-president of the Kaestner & Hecht Co., Chicago, Ill., elevator manufacturer, who handles Westinghouse direct traction elevator equipment in the Middle West.

H. D. James, manager of the control engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been re-elected president of the Engineers' Society of Western Pennsylvania. The other officers elected at the annual meeting were Frederick Crabtree, vice-president, and J. C. Hobbs and C. D. Terry, directors. Mr. James had served as director of the society for three years, and has been president for the last two years. He is a graduate of the University of Pennsylvania and a member of the American Institute of Electrical Engineers.

William J. Cleary has been appointed assistant general sales manager of the Sharon Pressed Steel Co., Sharon, Pa., manufacturer of pressed-steel frames, axle housings, brake drums, and heavy pressed steel stampings for automobiles, railroads, mines, mills, and factories. Mr. Cleary has been connected with the automotive industry for the last fourteen years, having been associated with the Studebaker Corporation as assistant general purchasing agent for twelve years and with the Willys Corporation, Elizabeth, N. J., as general purchasing agent for the last two years. His headquarters will be 1214 Dime Bank Bldg., Detroit, Mich., and his duties will cover the automotive industry in general.

* * *

NEW BOOK ON FORGING

Machine Forging. By Douglas T. Hamilton. 106 pages, 6 by 9 inches; 85 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

For many years inventors rarely crossed the threshold of the blacksmith shop. Hand-manipulated tools were used for many forging operations now performed in a fraction of the time entirely by mechanical means. A great deal has been accomplished during recent years in developing forging machines and various other classes of power-driven equipment for forge shops. The forging of bolts and rivets by machinery is an old method, but the use of machines for forging, welding and upsetting operations on machine parts of numerous shapes and sizes is a relatively modern development. The making of bolts, nuts, and rivets is an important and specialized branch of machine forging, and the construction and use of the machines and dies employed for this work are described in this treatise, as well as the application of machines designed for general forging operations. Dies designed for various typical operations are also described.

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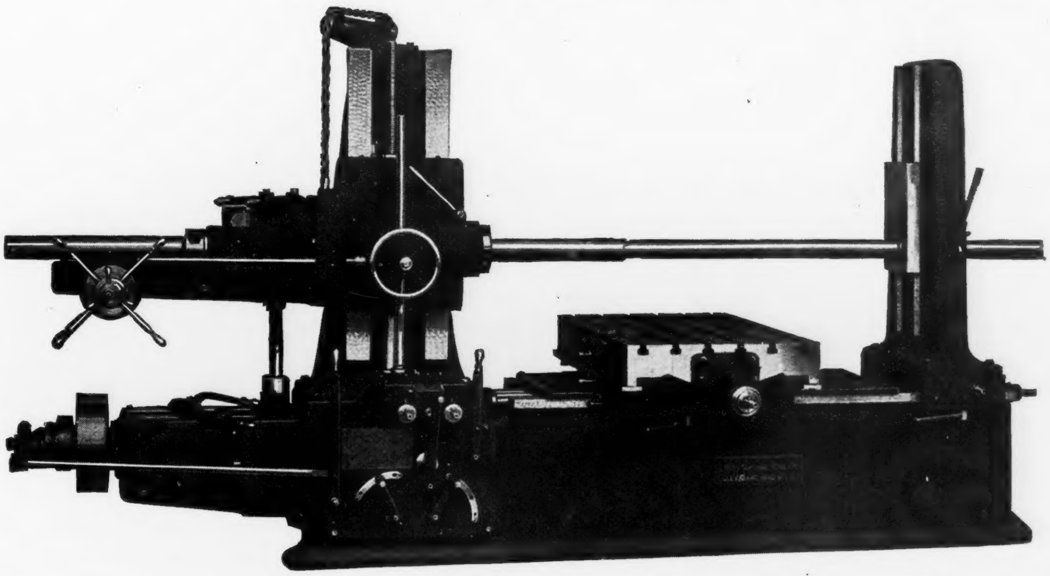

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Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

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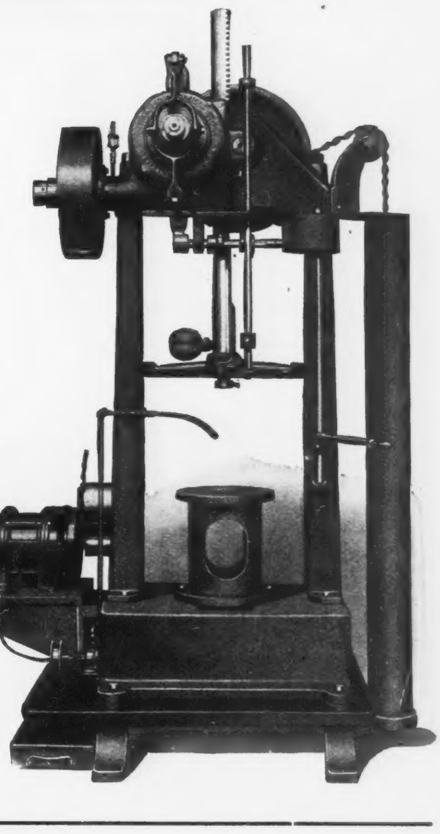
Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo, Japan.

OBITUARIES

JOHN H. STREETER, secretary and treasurer of the Riverside Iron Works, Chicago, Ill., died January 26.

A. B. HILER, for many years New York representative of the Jones & Lamson Machine Co., Springfield, Vt., died January 28, after a long period of suffering borne courageously and cheerfully. Mr. Hiler was born in Rockaway, N. J., in 1874, and received his early mechanical training at the Liberty Bicycle Works at Rockaway. Later he was employed in the screw machine department of the Thomas A. Edison Works in Orange, N. J., where he soon became foreman. About fifteen years ago he left the Edison plant and entered the employ of the Jones & Lamson Machine Co., remaining with this firm until the time of his death.

HOWARD V. LEWIS, of the Fitchburg Machine Works, Fitchburg, Mass., died from meningitis on January 26 at the Burbank Hospital in Fitchburg. He was born in Cincinnati in October, 1878, and graduated from Harvard University in 1900. Upon leaving college he was employed for a number of years by the American Tool Works of Cincinnati, and later was connected with the Fairbanks Co. of New York. After severing his connection with the Fairbanks Co. he became a manufacturers' representative, with headquarters in New York City, and subsequently was associated with the Allied Machinery Co. of America for about a year, six months of which he spent in Paris. He went to the Fitchburg Machine Works in November, 1915, and during his residence there built up a wide acquaintance and was highly respected by his business associates and many friends. He held the position of vice-president, secretary, and sales manager at the time of his death. Mr. Lewis is survived by his widow and four children.

GEORGE WILLIAM PECK of the Miner & Peck Mfg. Co., Derby, Conn., died at his home February 1, of kidney trouble. His father established the Miner & Peck Mfg. Co. in 1850 under the name of Milo Peck. At the death of his father in 1876, George W. Peck assumed active managership and continued as manager until his death. During his lifetime the concern was renamed, successively, Milo Peck & Co., Beecher & Peck, and the Miner & Peck Mfg. Co. In November, 1920, the company was purchased by the Birmingham Iron Foundry and removed to Derby. The firm name was retained, and Mr. Peck continued to serve as manager. In his years as manager he had continually developed the design of the Peck drop press and the Peck automatic lifter. He was well known and respected in the trade, and his passing will be regretted by a wide circle of friends. The Miner & Peck Mfg. Co. will continue its operation as before.

WILLIAM C. SARGENT, for twenty-two years secretary and also a director of the Chain Belt Co., Milwaukee, Wis., died suddenly on February 5 from heart failure. He was seventy-three years of age, and had been in ill health for several years. Mr. Sargent, prominent in industrial circles of Milwaukee and St. Paul, had a wide national acquaintanceship. He was born at Troy, N. Y., February 2, 1849. In 1871 he moved West, locating at St. Paul, where he organized the De Cou, Corliss & Sargent Co., manufacturer of sash and doors. He later became affiliated with the St. Paul Harvester Co., and it was while he was with this concern that he met C. W. Le Valley who subsequently founded the Chain Belt Co. of Milwaukee. This meeting was the beginning of a long business association, for in 1900 Mr. Sargent went to Milwaukee to become secretary and later a director of the Chain Belt Co. He was also a director of the Federal Malleable Co., West Allis, Wis. His father was one of the founders of the Terre Haute, Alton & St. Louis Railroad. Mr. Sargent established many of the early business connections of the Chain Belt Co., a large proportion of which are still among the company's jobbers.

COMING EVENTS

March 3—Sectional meeting of the American Society for Steel Treating in the Hotel McAlpin, 34th St. and Broadway, New York City. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

March 15—Meeting of the Pittsburg section of the American Institute of Electrical Engineers in Pittsburg, Pa. Chairman, H. W. Smith, General Engineering Dept., Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

March 16-18—Mid-winter meeting of the Taylor Society at the City Club, Philadelphia, Pa. Address of secretary, 29 W. 39th St., New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 20-22—Sixth annual convention of the American Gear Manufacturers' Association in Buffalo, N. Y.; headquarters, Lafayette Hotel. Secretary, F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa.

April 22-May 2—Sixth annual Swiss sample fair at Basle, Switzerland, in the Great Exhibition Bldg. For further information apply to F. Dossenbach, Director of the Official Information Bureau of Switzerland, 241 Fifth Ave., New York City.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 10-12—Ninth National Foreign Trade Convention in Philadelphia, Pa. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 18-20—Annual conference of the National Association of Office Managers in Washington, D. C. Secretary, F. L. Rowland, Gilbert & Barker Mfg. Co., Springfield, Mass. Guests are invited to attend.

June 5-9—Annual convention and exhibit of the American Foundrymen's Association and allied societies in Rochester, N. Y. Secretary, C. E. Hoyt, Marquette Bldg., 140 S. Dearborn St., Chicago, Ill.

June 15-24—International exhibition of foundry equipment and materials in Birmingham, England, in connection with the annual convention of the Institution of British Foundrymen.

June 26-July 1—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary, S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

SOCIETIES, SCHOOLS AND COLLEGES

California Polytechnic School, San Luis Obispo, Cal. Bulletin of information containing calendar and courses of study for 1921-1922.

American Welding Society, 33 W. 39th St., New York City, issued the first number of the proceedings of the society in January. It is the intention to issue the proceedings monthly, and they will include news items and reports of the society, local sections, the American Bureau of Welding, and the welding industry in general, as well as technical papers relating to the art of welding and its industrial application. Certain sections of the journal will be devoted to employment service, bibliography of current welding literature, names of new members, etc.

NEW BOOKS AND PAMPHLETS

Results of a Survey of Elevator Interlocks and an Analysis of Elevator Accident Statistics. 30 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 202 of the Bureau of Standards. Price, 5 cents.

Friction and Carrying Capacity of Ball and Roller Bearings. By H. L. Whittemore and S. N. Petrenko. 34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 201 of the Bureau of Standards. Price, 10 cents.

State Laws Affecting Working Women. 49 pages, 6 by 9 inches. Published by the Women's Bureau of the United States Department of Labor as Bulletin No. 16.

This report covers the state laws affecting working women which were in effect in the United States July 1, 1921. The majority of the laws affecting working women have been charted, and five maps have been made of the charts to give a picture of conditions of the country as a whole. The laws covered are those regulating the length of the working day or week; laws providing for a day of rest, one shorter work day, time for meals, and rest periods; night work laws; laws regulating home work; minimum-wage laws; and mothers' pension laws.

The Modern Gas Tractor. By Victor W. Page. 590 pages, 5 by 7 inches. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $3.

This is the fourth edition, revised and enlarged, of a book which treats exclusively of the design and construction of farm tractors and tractor power plants, and gives instructions relative to their care, operation, and repair. It illustrates and describes the different types and sizes of gasoline, kerosene, and oil tractors. The chapter on engine repairing has been considerably enlarged, and instructions are now given for repairing well-known and widely used tractor power plants, many new forms of which are described. The book is not written as a technical treatise, an endeavor having been made to present the principles of design in such a manner that they may be readily understood by those without technical knowledge. It is intended to bridge the gap between the purely technical work and the manufacturer's instruction book dealing with one specific construction.

Involute Spur Gears. By Earle Buckingham. 91 pages, 6 by 9 inches. Published by the Niles-Bement-Pond Co., 111 Broadway, New York City.

In this treatise the author has aimed to present in concise form an analysis of the problems involved in designing, producing, and testing involute spur gears. The five chapters cover the involute curve and its properties; the design of involute gear tooth profiles; methods of production; methods of testing gears; and the strength of gears. Chapter I deals with the equation of the involute curve; the action of one involute against another; the action of an involute against a straight line; the duration of contact between meshing gears; sliding and rolling contact; undercutting of the involute, and tooth and bearing pressures. This chapter on the characteristics of the involute curve is followed by a study, in Chapter II, of the best method of utilizing these characteristics. The requirements are considered first, and then the interchangeability of involute gear tooth forms and representative standard tooth forms, including a comparison of the Brown & Sharpe, Fellows, and Maag standards. In Chapter III methods of production are summarized, and mathematical analyses of the hob and pinion-shaped cutter are given. Chapter IV is descriptive of several appliances for testing gears to check the size, accuracy of tooth form, or running qualities. The last chapter gives representative formulas for calculating the strength of gears, including empirical formulas for determining the increment load for gears running at high speeds under heavy loads. This book is a valuable addition to the literature of gearing, and the author is well known to the readers of MACHINERY, especially in connection with his series of articles on the general subject of interchangeable manufacturing.

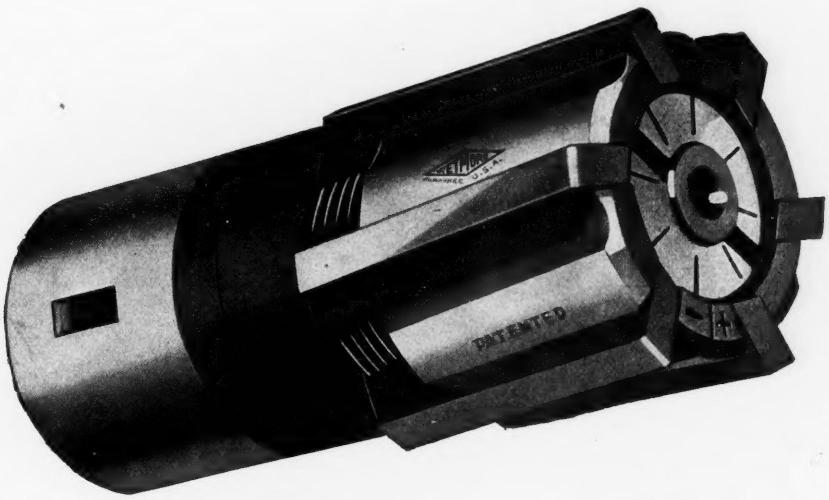
NEW CATALOGUES AND CIRCULARS

Porter Products Corporation, Keith Theater Bldg., Syracuse, N. Y. Leaflet illustrating and describing the Porter "Utility" offset screwdriver, for use in cramped quarters.

Hardinge Co., 120 Broadway, New York City. Bulletin 12, on Quigley fuel systems, describing the preparation, transportation, and burning of pulverized fuel.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Bulletin 48716, descriptive of the Sprague electric dynamometer of the research type.

Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular showing applications of the Cleveland electric tramrail system for transporting material in garages, foundries, warehouses, factories, boiler rooms, etc.



Where extreme accuracy and a glass-like finish are required, this Wetmore Expanding 6-Blade Standard Reamer has no superior.

More Holes to a Grind

Wetmore Expanding Reamers

SUPERINTENDENTS, production men and mechanics in many of America's largest plants say that Wetmore Expanding Reamers are more durable —and hence more economical—than any other expanding reamers they know of.

Combined with this greater capacity for day-in, day-out hard service, every Wetmore Reamer—from the 6-Blade Standard Reamer shown above to the new Wetmore Expanding Small Machine Reamers which are now being made in sizes under one-inch—has a proved reputation for guaranteed accuracy and quality of reaming.

DISTINCTIVE WETMORE FEATURES

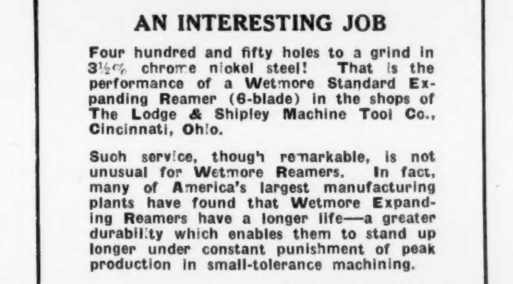
Among the advantages of Wetmore Expanding Reamers that are strongly appealing to users are the following:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, workmen say the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body—guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.



AN INTERESTING JOB

Four hundred and fifty holes to a grind in 3½% chrome nickel steel! That is the performance of a Wetmore Standard Expanding Reamer (6-blade) in the shops of The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

Such service, though remarkable, is not unusual for Wetmore Reamers. In fact, many of America's largest manufacturing plants have found that Wetmore Expanding Reamers have a longer life—a greater durability which enables them to stand up longer under constant punishment of peak production in small-tolerance machining.

If you are not using Wetmore Reamers, you should know more about them. Send us your name and we will mail you a valuable "hand-book" on expanding reamers, arbors and cylinder reaming sets—*free*. No obligation to you, of course.

WETMORE REAMER COMPANY

MILWAUKEE Box 21 WISCONSIN

(Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors and Thread Gauges)

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

Arva Stroud, 327 Broadway, New York City. Circular illustrating the application of R. V. 1-horsepower portable universal electric grinders for general work. The technical details are described, and instructions are given for upkeep and use.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets XV, XVI, and XVII containing dimensions and price lists for New Departure double- and single-row ball bearings, new "Radax" ball bearings, and magneto type ball bearings.

Monitor Controller Co., Baltimore, Md. Bulletin 101, discussing the starting of small alternating-current motors, and illustrating and describing Monitor "Thermaload" starters which are equipped with thermal-limit relays to protect against overload.

R & C Lap Co., Inc., Davenport, Iowa, has issued three new booklets covering the R & C line of laps for tool-room and production work, two of which have special reference to the lapping of automobile cylinders. Copies of the booklets will be sent upon request.

Cutter Co., Philadelphia, Pa. Circular illustrating and describing the "U-Re-Lite"—a circuit breaker for protecting electric motors and power and lighting circuits from overloading. The device is enclosed in a specially constructed steel case to insure safety of the operator.

Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa. Bulletin 10, describing Thwing thermo-electric pyrometers of the indicating and multiple-recording types, as well as Thwing multiple-record high-resistance recorders, for use in connection with indicating instruments.

Bryant Chucking Grinder Co., Springfield, Vt. Circular containing specifications for the Bryant No. 2 semi-automatic double-head hole grinder. Illustrations are presented showing the method of grinding pistons on this machine, as well as plan views of typical work-holding fixtures.

Sundh Engineering & Machine Co., 1105 Frankford Ave., Philadelphia, Pa. Circular describing the Sundh cable draw-bench, which is an electrically operated automatically controlled machine for producing rods, tubes, moldings and bars of various shapes by drawing through a die.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin LD 130, containing an article on "The Eye as Affected by Illumination." Bulletin LD 134, discussing the lighting of metal-working plants and containing illustrations showing examples of adequate illumination in machine shops.

Mansfield Steel Corporation, 954 E. Milwaukee Ave., Detroit, Mich. Loose-leaf circulars illustrating a trailer hitch, or hook, designed to couple with the standard trailer eye recommended by the Society of Automotive Engineers, and Mansfield front bumpers and radiator guards for automobile trucks.

Olson Mfg. Co., Worcester, Mass. Circulars illustrating the Olson magazine screwdriver, which is made with a hollow handle for holding the different sizes of blades that can be used with this tool. The tool is regularly furnished with three blades and one awl, which adapts it for handling both large and small work.

L. S. Starrett Co., Athol, Mass. Supplement to catalogue No. 22, containing illustrations, specifications and price lists of several new Starrett tools, including metal case for micrometers, micrometer depth gage, inspector's micrometer caliper gage, standard end measuring rods, squares, vernier height gages, thickness gages, etc.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular announcing a new and smaller Shepard electric hoist, which is known as the "Liftabout" and which may be operated by one man. The hoist is made in ½- and 1-ton capacities, for operation on either alternating or direct current. A few of the many applications for which this hoist is adapted are shown.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin HD501, describing P & H contractors' and builders' hoists and derricks. The illustrations show the single-, two-, and three-drum types of hoists, which are furnished for electric, gasoline or belt drive. The structural details of the P & H steel derrick are illustrated, and complete data in tabular form are included.

Cincinnati Grinder Co., Cincinnati, Ohio. Bulletin containing a description and illustrations of the Cincinnati automotive parts grinding machine, which has been especially developed for the repair shop, for use in grinding internal combustion engine parts. The machine is made in two styles, power feed and hand feed, and can be furnished for belt or motor drive. Copies will be sent to those interested upon request.

Mehl Machine Tool & Die Co., Roselle, N. J. Catalogue containing a prospectus of the tool service rendered by this company, which embraces the designing and manufacturing of jigs, fixtures, dies, gages, special machines, patterns, and precision equipment. The book contains a large number of illustrations, showing examples of the work produced, and interior views of the designing, pattern, manufacturing, and inspection departments.

Service Engineering Co., Inc., 25 Church St., New York City. Folder containing an outline of the activities and personnel of the company, which has been reorganized. The field covered is designing automatic machines; jigs and fixtures for economical manufacture; listing operations on parts; establishing tolerances or limits and gaging systems; planning lay-outs of machinery for increased production; and reorganization and appraisal.

Norton Co., Worcester, Mass. Form 907, containing information relative to alundum safety tile for stair treads, floors, and other uses where a slip-proof surface is desired. There are eleven pages of illustrations showing installations of alundum safety tile for different classes of service, and specifications for installing are included. A separate pamphlet is issued, which gives specifications for the proper installation of Norton alundum safety tile under various conditions.

Neidow-Cummings Co., 9 S. Clinton St., Chicago, Ill. Leaflet illustrating and describing "Airgrip" expanding mandrels, which can be loaded or unloaded without stopping the machine. The circular also illustrates the "Airgrip" piston manufacturing outfit, which includes an expanding piston arbor, a collet chuck, and an equalized drive arbor. This equipment may be used on any standard hand-operated, semi-automatic or full automatic machine, and will handle all sizes of pistons.

Mummert-Dixon Co., Hanover, Pa., is distributing a booklet to the trade entitled "Something Interesting about Stars," containing a study of some of the principal autumn and winter stars and constellations, besides a number of other subjects of general interest. The last pages of the book contain illustrations of the product of the company (which comprises oilstone grinders, radial grinders, oilstone wet tool grinders and facing heads) as well as a view of the pattern shop, which is equipped to handle all classes of pattern work.

Fellows Gear Shaper Co., Springfield, Vt. Booklet entitled "A New Development in Gear Cutting," describing a new type of gear shaper known as the No. 7, which has been developed for high production. The principle of operation and the mechanism of the machine are described in detail, as well as the method of operating, and other essential details. The construction is made clear by the liberal use of illustrations. The last chapter of the book shows examples of work, which indicate the possibilities of this type of machine for high production.

Cincinnati Milling Machine Co., Cincinnati, Ohio. Booklet entitled "Locomotive Repairs," containing data showing the adaptability of Cincinnati millers to the requirements of railway shops, and the reduction in costs that can be effected by milling this class of work. This book is of considerable interest, as the data is a record of actual performance in machining a large number of locomotive parts, and includes type of machine, speed, feed, material, stock removed, type and size of cutter, and time required for milling. The last few pages of the book are devoted to the use of Cincinnati universal millers in railroad tool-rooms.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular Reprint No. 104, containing an article on "Babbitting Motor Bearings," by J. S. Dean of the railway motor engineering department of the company. The article is illustrated with a number of photographs showing equipment used in the manufacture of babbitt metals, and diagrams showing the results of various tests of samples of alloys. The cost of Westinghouse lead-base babbitt metal is discussed in Folder 4475. This publication also describes the properties and applications of the lead-base babbitt metal known as Westinghouse alloy No. 25 and the babbitt known as Westinghouse alloy No. 14.

Joseph T. Ryerson & Son, Chicago, Ill., has published the second issue of its "Machinery Quarterly" which forms the machinery and tool section of the "Ryerson Steel Service Book." It is not intended that this book should be regarded as a complete machinery catalogue, the purpose being to place before machinery users condensed descriptive material covering the line of equipment furnished. Each issue shows a representative line of Ryerson equipment, including one or more machines or tools of each of the various classes with a brief description and specifications. This section shows lathes, planers, drilling machines, milling machines, grinders, power hammers, saws, bulldozers, punches and shears, bending rolls, riveters, threading and cutting-off machines, and many other types of metal-working machinery and equipment.

Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, Ill. Instruction book covering the assembly and use of oxy-acetylene welding, cutting, lead-burning, and carbon-burning equipment. The booklet presents the basic principles of oxy-acetylene welding and cutting, and is illustrated by views of "Torchweld" equipment. It is written in a style that can be easily comprehended by the shop man, and contains eighteen chapters dealing with the following subjects: Production of the Gases; Welding Materials and Supplies; Gas Pressure Regulators; "Torchweld" Welding Torches; the Welding Flame; Fundamentals of Welding; General Information for Welding; Welding Shop Suggestions; General Repair Work; Steel Welding; Production Work on Steel; Boiler Welding; Cast Iron, Copper, Brass and Aluminum Welding; "Torchweld" Cutting Torches; Metal Cutting; Lead Welding; and Carbon Burning.

TRADE NOTES

Cashman Tool Co., Waynesboro, Pa., has sold its property, building, and equipment to William H. Strauss, manager of the Wayne Tool Mfg. Co., Waynesboro.

Dale Machinery Co., 56 Lafayette St., New York City, dealer in machinery and tools, has moved its offices to 17 E. 42nd St. in the National City Bank Bldg., where larger quarters have been secured.

F. A. Calhoun Co., Lincoln Trust Bldg., Jersey City, N. J., has been appointed eastern representative in the New England and Middle Atlantic states for "Case-Hardo," a casehardening compound used for performing the same work as cyanide.

Surface Combustion Co., Inc., 366-368 Gerard Ave., Bronx, New York City, industrial furnace engineers and manufacturers, have secured the exclusive license for exploiting the Andrews rust-proofing process in the United States and foreign countries.

International Purchasing & Engineering Co., Inc., 506 McKerchey Bldg., Detroit, Mich., announces that it has made a reduction of approximately 15 per cent on the price of Van Dresser electric driven machines. No change has been made in the price of the hand or drill press types.

Sundh Engineering & Machine Co., Philadelphia, Pa., manufacturer of finishing machinery for brass, copper, and steel strip mills, has closed its branch office at 11th Ave. and 26th St., New York, and opened a downtown office in Philadelphia in the Otis Bldg., 16th and Sansom Sts.

Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y., manufacturer of portable oil burners, torches, furnaces, etc., has moved its Philadelphia office to 1726 Sansom St., (Bell telephone, Spruce 5626). Herbert Vogelsang, who has been connected with the company for six years, will be in charge of the office.

Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill., general sales agent for the Logan air-operated chucks, has discontinued business, and the general sales office of the **Logansport Machine Co.** has been moved to the factory at Logansport, Ind. Frank G. Payson will be located at Logansport as manager of sales.

Royersford Foundry & Machine Co., 54 N. 5th St., Philadelphia, Pa., manufacturer of Sells roller bearings, hangers, and other products, has made arrangements to have its full line of hangers handled in Chicago by the Clinton Supply Co., Inc., 110-112 S. Clinton St. This company will also act as distributor of Sells roller bearings.

Ingersoll-Rand Co., 11 Broadway, New York City, has been appointed general sales agent for the gas engines manufactured by the Rathbun Jones Engineering Co. of Toledo, Ohio. The Rathbun gas engines are of the vertical multi-cylinder type and are built to operate on natural, illuminating, producer, coke oven, oil still and other forms of gases that can be used in an internal combustion engine. The sizes range from 100 to 1450 brake horsepower.

Jones, MacNeal & Camp, Inc., formerly located at 522 S. Clinton St., Chicago, Ill., have moved to Warsaw, Ind., where they have acquired the factory previously occupied by the Blackhawk Tire & Rubber Co. This plant has 31,000 square feet of floor space, which will be devoted to the manufacture of a full line of "Power King" portable electric drills, having capacities for tools from 3/16 to 1 inch in diameter. A business office will be maintained in Chicago.

Quigley Furnace Specialties Co., Inc., 26 Cortlandt St., New York City, announces that its pulverized fuel department has been acquired by the Hardinge Co., 120 Broadway, New York City, which will continue the conduct of the business along the same lines as heretofore, the organization of the engineering department having been taken over practically intact. The rapid growth of the refractory specialties business of the Quigley company has made it advisable for the company to devote its entire attention to this branch of the work.

Oliver Machinery Co., Grand Rapids, Mich., manufacturer of woodworking machinery and machine tools, has established a new branch office at 716 Lincoln Bank Bldg., Minneapolis, Minn., in order to provide more efficient service for industrial plants, pattern shops, metal-workers, and woodworkers in the Northwest. George C. Ramer, who has had a wide experience in the sales department of the company, is manager of the office. The territory served by the new office consists of Minnesota, North and South Dakota, Nebraska, western Iowa, and western Wisconsin.

Cadillac Tool Co., Detroit, Mich., has been dissolved and is succeeded by a new concern which has been incorporated under the name of the **Cadillac Machinery Co.** The new company will retain the personnel of the Cadillac Tool Co., which was engaged in the sale of machine tools and which also did some manufacturing, but it will devote its entire efforts to selling machine tools. The president of the company is C. L. Campbell, and the other members of the organization are C. E. French, L. E. Bugbee, C. G. Valentine, and R. J. Borneman. The territory will be the same as that covered by the Cadillac Tool Co. The salesroom is located on the ground floor of the Bordell Bldg., East Lafayette and Beaubien Sts., Detroit.